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CIVIL ENGINEERING.

Extracts from the Report of Prof. Alex. D. Bache, *Superintendent of the Coast Survey, showing the Progress of that Work for the year ending November*, 1849.

Continued from page 152.

Section VI.—*From the St. Mary's River to St. Joseph's Bay, Coast of Florida, and including the Florida Reefs and Keys.*—(Sketch F.)

No portion of the coast of the United States has stronger claims than this to a speedy and minute survey, whether we regard the dangers to navigation, the amount of commerce which passes by it, or the various localities of the Union interested in the trading vessels. The representations made on this subject from New York have been as strong and as urgent as those from Florida itself, and the lists of wrecks annually presented under authority of the board of underwriters furnish the best evidence of the necessity of the work. In the year 1848, 41 vessels hailing from 20 different ports, and valued with their cargoes at $1,282,000, were wrecked upon this coast; the amount of salvage awarded upon them was $125,800, and the total amount of expenses $200,000.—(Appendix No. 14.)

Were the dangers of this coast made known by accurate charts, the direction and force of currents duly examined, the action of tides and character of winds investigated, the positions for lighthouses, beacons, and buoys suitably determined, and the necessary aids to navigation provided, this loss of property would be much diminished.

In reply to a resolution of the Senate of the United States, the Secretary of the Treasury recommended a special appropriation for the more speedy survey of this part of the coast than could be secured from its proportion of the ordinary appropriation for the survey of the coast of the United States. The amount suggested in my report, transmitted by the Secretary of the Treasury to the Senate, was about sixty thousand dollars per annum. For the discussion of this subject, and the information collected in relation to it, I refer to this report, in Ex. Doc. No. 30, Senate, 30th Congress, 2d session. The amount appropriated for the present fiscal year was thirty thousand dollars, furnishing means for a gradual but not a speedy survey. On a statement to the Treasury Department of the urgency of the case, I was authorized by the present Secretary to proceed at once with the work in anticipation of the fiscal year, and organized two triangulation parties and a hydrographic party to proceed at once to commence the survey. Various circumstances beyond my control, and beyond that of the officers in charge of the parties, prevented the full effect of my plans, but a satisfactory beginning of the work had been already made when the advance of the summer rendered its further prosecution impracticable. The land parties have, with increased force, resumed their operations at the earliest period of the autumn when they could work with safety. The sketch shows the progress of the work made before the summer rendered it necessary to close operations, and the details are given in the following paragraphs under their appropriate heads.

The first object proposed was to connect the survey already executed by Major Hartman Bache, of the topographical engineers, in and near Key West harbor, with the coast survey, and to extend the limits of the hydrography; to furnish the basis of the hydrographic reconnaissance near Key Vacas and the Pine islands, in reference to channels across the reef alleged to exist there, and of Bahia Honda, in reference to its changes. While this hydrographic work was doing, to prepare for the regular operations of the survey by commencing first at Cape Florida, and passing towards Carysfort reef, and subsequently by a base near Cape Sable, and a connexion with the keys and Florida reef, to push the regular survey both eastward to meet the former, and westward towards Key West, following up the land work closely by the hydrography.

While on the coast of Key Biscayne bay, Mr. Gerdes, in accordance with a request from the Secretary of the Treasury, ran a line of levels from the Everglades to the low-water mark on the gulf, following the general direction of the Miami river, from the upper falls to near its entrance into Key Biscayne bay. The general course of the line was ESE., its length $3\frac{3}{4}$ miles, and the level of the water in the glades was 6 feet 2·5 inches above low tide in the gulf. When the levellings were made, the level of the water in the glades was stated to be lower, and the tide in the gulf higher, than ordinary, and Mr. Gerdes, therefore, placed two permanent bench-marks for future reference. No means were at his disposal for ascertaining the depth of water in the Everglades. The average fall per mile thus ascertained by Mr. Gerdes is nineteen inches and eighty-seven hundredths. The *average fall* of the Ohio and Mississippi, from Pittsburg to the sea is stated at four inches and thirty-four hundredths per mile.

APPENDIX No. 2.—*Results of the Coast Survey at different periods from* 1807 *to* 1849.

	From 1807 to 1819.	From 1832 to 1844.	From 1844 to 1849.	Totals.
Reconnaissance, area in square miles,	560	18,103	22,544	41,207
Triangulation, do. do.	450	14,483	* 19,309	34,242
Extent of coast line, . .	—	310	405	715
Do. shore line, reckoning bays, sounds, &c	—	3,215	4,211	7,426
Astronomical stations, number of .	3	11	47	61
Magnetic stations do.	—	10	88	98
Vertical angles do.	—	7	34	41
Base lines do.	—	1	4	5
Preliminary base lines do.	2	—	3	5
Topography, area in square miles,	—	6,222	2,755	8,977
Length of shore line, . .	—	6,100	4,055	10,155
Hydrography, area in square miles,	—	† 9,623	‡ 15,910	25,533
Hydrography, number of soundings,	—	808,147	951,002	1,759,149
Gulf stream, number of soundings for temperature, . . .	—	—	1,410	1,410
Gulf stream, fathoms of line, .	—	—	139,747	139,747
Current stations, number of .	—	—	223	223
Tidal stations, do. . .	—	13	60	73
Specimens of bottom, do. .	—	500	4,098	4,598
Total number of manuscript maps, .	—	326	295	‖621
Of these manuscript maps, number prepared in office, being reductions, &c.	—	29	123	152
Original topographical maps, number of	—	160	100	§260
Containing sheets, do.	—	298	131	429
Original charts, do.	—	103	72	¶175
Duplicates, . . .	—	34	—	34
Containing sheets, number of .	—	236	160	396
Records, triangulation bases, &c., number of volumes, . . .	4	95	233	332
Astronomical observations, &c., vols.	1	16	140	157
Computations, geodetic, &c., do.	1	78	138	217
Computations, astronomical, do.	2	4	138	144
Magnetic observations, do.	—	4	37	41
Magnetic computations, do.	—	—	15	15
Geodetic books, duplicates, do.	1	26	128	155
Meteorological books, do.	—	2	7	9
Meteorological books, duplicates, do.	—	—	3	3
Original hydrographical books, soundings and angles, number of vols.	—	179	380	559
Duplicate do., do.	—	27	32	59
Hydrographical books, tidal and current observations, and tidal reductions, vols.	—	8	158	166
Astronomical differences of longitude,	—	—	66	66
Total of records, . .	9	439	1,373	1,928
Engraved plates of maps, number of	—	5	24	29
Engraved plates electrotyped, do.	—	—	8	8
Published maps, do.	—	—	21	21
Printed sheets of maps, do.	—	—	24,249	24,249
Do. do. do. distributed, do.	—	—	7,678	7,678
Do. do. do. sale agents do.	—	—	12,979	12,979
Volumes in the library, . .	—	—	—	655
Instruments, &c., value of . .	—	—	—	$149,513

* In sections III, IV, VIII, and IX, the primary and secondary triangulations are united in general.

† 5000 of off-shore work. ‡ 11,000 of off-shore work. ‖ 11,215 sq. feet of paper.
§ 4056 square feet of paper. ¶ 5891 square feet of paper.

APPENDIX No. 5.—*Report of Professor O. M. Mitchel, of Cincinnati, on the Mechanical Record of Astronomical Observations.*

CINCINNATI, *November* 10, 1849.

SIR: In accordance with your request, I have the honor to present to you the following report on the subject of the mechanical record of astronomical observations.

During the month of October, 1848, while engaged in company with S. C. Walker, Esq., assistant United States coast survey, in observing for difference of longitude between Philadelphia and Cincinnati by the telegraph, it was perceived that in this operation great advantage would be gained, in case the Philadelphia clock could be made to record its beats in the Cincinnati observatory. Mr. Walker gave me to understand that this problem had been discussed by yourself and others, and that a mechanical solution had been proposed by Professor Bond, of the Cambridge observatory, but had not been executed.*

On the afternoon of the 26th October, 1848, the subject was discussed by Mr. Walker and myself, in the presence of several gentlemen, who were then assistants in the Cincinnati observatory, and in the United States coast survey. After closing the conversations, I reflected on the most simple mechanical means by which the desired object might be effected, and on the same evening executed the first rough plan which occurred to me. The pendulum of a common brass clock was connected with one pole of the battery, and at each vibration touched a small wire which was connected with the other pole of the same battery. At every such contact a current passed and operated the recording pin of a Morse's register, giving a dot for every alternate second on the running fillet.

This was the first rude contrivance, and in its application it manifestly interfered with the rate of the clock. In case the spring was reduced to sufficient delicacy to produce no sensible effect on the pendulum, then the contact was not sufficiently firm to give a sure connexion.

Further reflection on the subject that night suggested to me another plan, which was executed on the following morning. This second plan consisted in attaching to the lower part of the pendulum a small wire, which, at each vibration, dipped into a cup of mercury connected with the other pole of the battery. In this case, as in the former, the current passed through the pendulum of the clock. This was, however, by no means necessary to the plan, as the wire could readily be insulated, and the pendulum would then only be used as the moving power.

On presenting this plan to Mr. Walker, he expressed the opinion that any interference with the pendulum would entail uncertainty on the rate of the clock; and hence it would become inapplicable in practice for the ordinary work of an observatory.

At that time the Cincinnati observatory had no astronomical clock, and it was impossible to try the experiment. I was, however, satisfied that in case the pendulum was taxed to either make or break the circuit, this could readily be made absolutely constant, and hence as good a rate could be given to the clock with this permanent fixture as without it. Subse-

* The drawings had been submitted to me, and approved, and the work was in the course of execution.—A. D. B.

quent experiment has demonstrated the truth of this opinion, as has been shown by Mr. Walker, as well as by my own experiments since the arrival of a new sidereal clock recently presented to the Cincinnati observatory.

After some difficulty I succeeded in obtaining the privilege of using for a short time a solar clock, the property of one of our citizens, and the evening of the 28th of October, 1848, was fixed upon for an experiment between Philadelphia and Cincinnati for difference of longitude by the new method. The morning of the day proved stormy, and the clock was not removed to the observatory.

Having organized a party for the preliminary surveys of the Ohio and Mississippi railroad on the first of November, I found it necessary to leave the observatory, and my experiments were broken off, and could not be resumed until the close of January, 1849. It was, however, agreed between Mr. Walker and myself that on the arrival of the sidereal clock then ordered, we would resume the experiments and work between Philadelphia and Cincinnati.

A few experiments made before leaving the observatory in October, 1848, on the uniformity with which the Morse fillet could be delivered, showed great irregularity of motion, and convinced me that it would be inapplicable to the requirements of astronomy. One hundred seconds recorded on the fillet were never equal to any other hundred seconds; hence the second spaces were of unequal length, and any fixed scale for their measurement would be impossible.

My present method of recording right ascensions was communicated by letter to you under date of the 5th of February, 1849. The machinery was not finished until some seven or eight weeks after that date, in consequence of my absence from the observatory.

I shall now proceed to describe this machinery, and that subsequently invented for the record of declinations, in as few words as possible.

Any machinery to be useful in the record of right ascensions, must fulfil the following conditions, viz:

1. The record of time and observations must be accurately, distinctly, and perspicuously made.

2. The machinery must be simple, easily adjusted, not liable to the effects of atmospheric changes.

3. The record must be simple, easily read, and condensed within a narrow and convenient compass.

To accomplish the fulfilment of these conditions, I conceived the following mechanical contrivance:

1. A horizontal disk is caused to revolve on a vertical axis with uniform velocity.

2. This disk carries either a metal plate or a paper disk, on which the time and observations are recorded by pens drawn by electro-magnets.

3. The time pen is operated by the sidereal clock, by attaching a delicate cruciform lever to the pendulum by a spider's web. This lever at every alternate second dips into a cup of mercury, forms the connexion, and a second's dot is struck by the time pen on the paper or metallic disk revolving beneath the pen.

4. The pen for recording observations is under the control of the observer at the instrument, who records his observations by simply touching

a key, which, by mercurial connexions, forms the circuit, and operates the observation pen.

5. When the disk performs one revolution, it trips on a railway, and is thrown forward the tenth of an inch by self-acting machinery, when a new circumference of time dots is commenced.

In the use of this machinery we commence by adjusting the disk to revolve once in every sixty seconds. This is usually accomplished in five or six minutes. It is then adjusted to trip between the 59th and 0 second of every minute. This adjustment occupies about three minutes. These being completed, the 0 second of every minute falls in a right line radiating from the centre of the disk. The 2d, 4th, 6th, &c., seconds radiate in right lines in like manner.

Noting on the face of the disk any hour and minute, and second, from the face of the clock, the entire disk presents a perfect circular time scale, as easily read as a table of logarithms, or other tables arranged in horizontal and vertical columns.

The observation dots fall intermediate between the minute circles and second dots, and are struck so as to distinguish them by form from the time dots.

Having closed all the mechanical arrangements for observing in R. A., I introduced a new diaphragm containing 25 wires, arranged in groups of *seven*, by making the *seventh*, the *thirteenth*, and *nineteenth* wires a little longer than the others. As many as *fifty* wires have been used, but for ordinary observing the number has been fixed at twenty-five. The disk has now been in use for several months, and is found to be very controllable and convenient; its adjustments are rapidly made, and the uniformity of its motion is such as to give a record of time far more accurate than any observations can be made.

The time and observation pens are so constructed that they cannot rest upon the disk any sensible time. By making the magnetic connexion for ever so long a time, nothing but a minute round dot can be made.

By this machinery we are enabled to observe with an accuracy in which the actual errors on any one wire struck and recorded are but one-half of the average Greenwich errors on one wire. Hence *one* wire by the new method becomes equal in weight to four Greenwich wires, and a 25-wire new observation is equal to about 15 of the 7-wire observations, as made at Greenwich. This refers to average work as already done at the Cincinnati observatory. Should experience enable us to equal our best work, our errors would be only one-fourth of the Greenwich errors, and the above motion would be greatly increased in favor of the new methods.

We are now able to observe *double stars*, in which the diff. in R. A. exceeds half a second of time with astonishing accuracy. Among other stars we have observed β^1 and β^2 Lyræ, 61 Cygni, and β Cephei.

We find by an examination of the intervals of the wires, as determined by double stars and by single star observations, that our work in double stars is not quite so accurate as that involving only one object; and yet, from observations of the former kind, our mean difference from the mean show a probable error of any one mean diff. of R. A. not to exceed *five thousandths* of one second of time, as deduced from 25-wire observations.

I now proceed to give some account of the mechanical means for recording *differences of declination.*

Soon after my attention was directed to the examination of the subject of a mechanical record of R. A., I conceived a method of recording declinations; but being unwilling to divide my attention, this plan was not executed until the beginning of August, 1849.

I have attached to the axis of the transit or equatorial, by a strong clamp-collar, an arm, which (as now in use) is about 6 feet in length. To this arm such a form is given as to avoid, as far as possible, any sensible flexure from a position out of the vertical. To the upper part of this arm an electro-magnet is fixed, which operates a double lever armed with a steel recording pen. To receive the record, a metallic plate is placed vertically on the face of the transit pier, moving in ways parallel to the circles described by the recording pen. To use this instrument for record, the observer sets for his standard star; the arm is then brought to the vertical and clamped. The instrument is then clamped, and a tangent screw gives to the observer his slow motion for bringing the star to the declination wires. When the star is bisected the observer strikes the key with his finger, the circuit is formed, the electro-magnet brings the pen in contact with the record plate, and, while in contact, the plate descends in its ways, and a zero line is described on the plate, from which all differences of declination are afterwards read. At present we use three declination wires, and there are three zero lines obtained from the standard star. The number may be increased up to *five*, or even *ten*, if desired; and in this way almost any number of declinations may be obtained during one and the same transit. When the difference of declination of one star has been recorded, the plate moves upward about the tenth of an inch, and is ready for the next record.

It will be seen that we are now recording a declination on a circle of nearly *twelve feet in diameter.* This may be increased to *forty* feet, if desirable. The only source of sensible error yet perceived in this method arises from possible flexure. This may readily be ascertained by observing the same stars with the arm vertically *down* and vertically *up.* The first set of differences will be too short, the second will be too long, by the error of flexure. Their difference will be the double error. No sensible value has yet been obtained. The arm, as now used, never leaves the vertical more than 5° of arc, and its form is such as to secure it from sensible flexure absolutely within such limits.

To read the records of R. A. and declination, certain machinery has been constructed. The R. A. is read by a sector composed of two legs, revolving on a pivot, one of which bears an arc divided to read to hundredths of a second of time.

To read the record of declination, the plate is laid on a carriage and leveled by four screws; a movable arc, divided into equal parts, whose values have been absolutely determined and tabulated, is adjusted so that its ○ coincides with the zero line of the record. It then glides on its ways parallel to and just above the record plate. A micrometer screw and microscope, with a spider's web, reads the fractions of the equal parts into which the arc is divided, with great facility and with great accuracy. In applying this machinery to the purpose of cataloguing, all light is dis-

pensed with, and the wires usually employed are superseded by *occulting bars*. The R. A. is taken by ingress and egress, while the star is bisected by the edge of the horizontal occulting bar for declination.

The system of record is the following:

The observer fixes the width of his zone in proportion to the number of stars in the region under examination. An assistant records on the catalogue the number of the star and its magnitude as called out by the observer. The stars are recorded in R. A. on the disk, and in declination on the sliding plate. The standard stars are readily distinguished as their R. A. and declination are known, and the differences of R. A. and declination are read off with great facility from the two records.

Such is the rapidity with which this work may be executed, that, in an experiment made on the evening of the ————, I recorded, in twenty minutes of time, no less than *one hundred and three* stars. The R. A. was observed on a single occulting bar, while the declination was carefully taken on the horizontal bar. I feel confident that the R. A. in no instance was out more than three-tenths of a second of time, while the declinations were as well observed as is usually done by the old methods.

I am delayed from commencing actual work in cataloguing, by not having yet received my instruments for measuring up differences of declination. Thus far I have used the micrometer of the equatorial, which only furnishes relative and not absolute results. In a few days the instrument is to be finished, and, as soon as received, I will communicate specimens of the work.

I find my disk and its appliances of signal value in the investigation of the problem of wave-time in electrical currents. I have performed a series of experiments on the following plan, which yield some very interesting results:

Two pens, with steel points, are so placed as to strike minute dots on a metal plate revolving beneath them on the disk. The sidereal clock is connected with the two local batteries driving these pens, so that the clock beats are recorded at the same absolute moment by the two local circuits. One of these pens is not changed, but remains ever in the same condition, driven by a short circuit; while the other can be placed at pleasure under the power of a circuit extending to Pittsburg and back, along the wires, a distance of 603 miles.

It was soon discovered that the adjustment of the receiving magnet exercised an important influence on the pen operated by the circuit closed by the receiving magnet. When the armature came up firmly, the pen was brought down quick; while a feeble movement of the armature caused delay in the pen, amounting to a tenth of a second, or even more. Hence it became important to adjust in such manner as to obtain equality in the force of the long and short circuits driving alternately the *variable* pen.

When this was done, the alternations were made from *short* to *long* circuits; and in case the long circuit produced any delay, it could not be detected by the ear. This was decided by the following experiment:

The persons who changed the circuits agreed among themselves as to the order of their changes. Those listening knew nothing of their private agreement, so that the judgment was unbiassed. After five minutes of trial, the operators asked what changes, if any, had been made. No one

could answer, and all believed that no changes had been made; while, in reality, the changes had been effected every *ten seconds* during the whole experiment.

In case the ear can detect differences of time equal to one-hundredth of a second—which, from my own experiments, is certain—then the velocity of the wave cannot be less than sixty thousand miles per second. In case the ear can detect differences of time amounting to half a hundredth, then the limit cannot fall below one hundred and twenty thousand miles per second.

I soon discovered that the force of the electric current was subject to perpetual change of a minute character, but not to be neglected in so delicate an investigation.

This was exhibited in the armature time, as recorded by the pen, carried by an elastic handle.

Whether the changes of armature time are entirely due to changes in the current, or to differences of connexion, remains to be determined. They are, probably, dependent on both causes.

It now became necessary to cause both pens to record their armature time, and, by increasing or decreasing the local battery of the variable pen, to bring the force of the long and short circuits to as near an equality as possible.

This last experiment will be recorded on the metallic disk, and will be printed for distribution. It has been delayed by a break in the line, and as the limit in time for this report has come round, I send it unfinished.

Respectfully, your obedient servant,

O. M. Mitchel.

Dr. A. D. Bache,
Superintendent U. S. Coast Survey.

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*A Chapter in the History of Railway Locomotion.**

It has been observed by some sapient moralizer, that when a great work is to be done, a man is always found to do it—or rather, he steps forward of his own accord, and undertakes the job. Whilst we are not prepared implicitly to adhere to this wise saw, we cannot well escape its application in railway history, for it must be allowed that when, thirty years ago, the increasing commercial importance of the country demanded a proportionately improved mode of conveyance, which should combine the requisites of economy, speed, and commercial practicability, George Stephenson got up and supplied the deficiency. This he did by an extension of the embryo system then partially in use in his own district of the north of England, for the conveyance of coals to the staiths, or shipping places.

The extent of these colliery lines did not exceed four or five miles, and, looking at the imperfection of the power employed upon them, little could be said as to their chance of superseding horse labor. It cannot, nevertheless, be said, that, even at this early date, the great utility inherent in the system was not tolerably apparent to a few of those early mechanicians whose names have now become interwoven with its fame. Their acute

* From the Glasgow Practical Mechanic's Journal, for June, 1850.

perception enabled them to distinguish, through the then crude and imperfect state of applied mechanics, the immense resources which lay shrouded in futurity, waiting for time and human experience to develope them. The first iron railway ever laid down, to the extent of twenty-five miles, was the Stockton and Darlington line, which was opened on the 27th of September, 1825, the management of the working power, consisting of locomotives, stationary engines, and horses, being entrusted to Mr. Timothy Hackworth, of whose efforts in the introduction of locomotive mechanism we here propose to treat. Twenty miles were worked by locomotives and horses, the two classes of power being placed in competition with each other.* Owing to the inefficient condition of the locomotive power, the Company had all but determined to abandon steam in favor of horses, when Mr. Hackworth proposed to construct an engine suitable for working the traffic on this extent of line. This offer was accepted by the Company, and, by way of economy, it was determined that the boiler of Wilson's engine should be made to serve for the new one. This boiler was a plain cylinder, 13 feet in length, and 4 feet 4 inches in diameter. The heating surface was obtained from a double tube of malleable iron, in the form of the letter U, traversing the whole length of boiler. One side of this tube was made available for the fire-grate, and the heated vapor being passed through it, was returned by the opposite one to the chimney, which was actually a vertical continuation of this end. With this contrivance the engine had a heating surface double that of any other engine of its time. She was carried on six 4-feet wheels, four of them being spring-mounted, and was the earliest of the six-wheel coupled class. The cylinders, 11 inches in diameter, and 20 inches stroke, were placed vertically at what is now the smoke-box end of the engine, and worked directly upon the first pair of wheels. At the same end was attached a malleable iron cistern, into which the water passed from the tank, previous to being introduced into the boiler, the driver having the power of regulating the supply; and a pipe from the steam exhaust was led into the cistern, for the purpose of admitting steam at pleasure, to heat the water. Another pipe was provided for the purpose of leading off a steam jet from the exhaust-pipe at the chimney end, for discharge beneath the grate, the intention being to facilitate combustion.

In addition to its being the original of a class of engines now so universal, this engine was the first which had a blast-pipe fitted to it, the whole of the exhaust steam—excepting only such a portion as was required for the purposes before alluded to—being conveyed into the centre of the chimney, and there thrown out in a jet from a conical pipe. She was named the "Royal George," and commenced working in October, 1827.

As an exposition of her superiority over the horses—which, be it remembered, were at this time in the ascendant as regards their employment on railways—we may compare the actual results of the two systems of working.

Cost of "Royal George," £425; number of tons conveyed by her in one year, (1828,) 22,442 tons over twenty miles; cost of conveyance, ¼d. per ton per mile, or, including all repairs and maintenance, and interest on

* There were, at this time, five locomotives on the line; four built by Mr. Stephenson & Co., of Forth street, Newcastle, and one by Mr. Wilson, of the same place.

sunk capital, at 10 per cent., £466; an economy in working which is rarely exceeded at the present day, after a lapse of twenty-three years. The cost of the same work performed by horses was £998, showing a difference of £532 in favor of this engine over the animal power.

The points of improvement in the "Royal George" which conduced to this important result, evidencing not only her great superiority over her compeers, but the vast resources of the imperfectly developed locomotive system, were simply these: the increased evaporative surface of the boiler; the perfect command over heavy loads in all states of the weather, by reason of the superior tractive adhesion derived from the six coupled wheels; and the introduction of the blast-pipe, an invention which alone will carry down the name of Hackworth to future ages in connexion with early locomotive history.

Up to the period of which we write, no really efficient locomotive was in use, as the steam pressure invariably fell, in spite of the best efforts of the driver; and the superiority of the "Royal George," in this respect alone, at once elevated it far above its contemporaries, for it was capable of maintaining a speed of nine miles per hour throughout its run of twenty miles, in all weathers.

Amongst all the details of the locomotive, perhaps no one point has afforded so much material for speculative invention as the exhaust draft apparatus, and yet, out of the accumulation of schemes for this purpose, which have taken every devisable shape, as fanners and bellows, nothing has arisen to supersede the original blast-pipe in the smallest degree. After twenty years' experience, nothing more has been elucidated than the simple fact, that to get it as wide as possible is the ultimatum of perfection. In naming the novelties brought out in the "Royal George," we must not forget to add, that she possessed the first short-stroked force-pump, as also the first set of adjustable springs for the safety-valves, instead of weights.

To illustrate the state of popular feeling prevalent at this time in reference to the contest between locomotives and horses on the Stockton and Darlington line, we extract a few passages from a letter addressed by Mr. Robert Stephenson to Mr. Hackworth, dated Liverpool, July 7, 1828:—

"The directors having heard here, by some channel or other, not favorable to the locomotive engines, that there has always been a great number of horses on the line, and that the horses were beating the engines off,—in answer to this I understood you to say, that at one time you had completely run the horses off, but in consequence of the late accident, and the heavy engine being laid aside, you had been obliged to employ horses again. Was not this the sole cause of the horses being employed? and was there not an instance, a little while ago, of the horses being entirely removed from the line of road? Please write me by return of post, or, at all events at your earliest convenience, answers to these queries. I cannot wonder at the traveling engines having so much to contend with, when I come in contact with enemies to them every hour; and they prove to be enemies without reason, they oppose the engines merely because certain things have been said against them."

The accident alluded to in this extract was the explosion of one of the engines, supposed to have been caused by a driver having neglected to

remove a spring which was employed to steady the weight upon the safety-valve lever during running, this removal being necessary whenever the engine stopped. The "heavy engine" was the "Royal George," then undergoing repairs; hence the want of the two engines involved the necessity of employing horses until the repairs were effected. In a letter written by Mr. G. Stephenson, dated Liverpool, July 25, 1828, the following occurs:—

"Brandreth has given a report here that you are going to lay off the locomotive engines. Is it so? It was a great pity that the accident took place with the tubes. We have tried the new locomotive engine at Bolton; we have also tried the blast to it for burning coke, and I believe it will answer. There are two bellows, worked by two eccentrics underneath the tender."

In the early part of the year 1829, as the Liverpool and Manchester line approached completion, the directors laid their heads together to determine on what kind of power they were to use. They had, in the previous year, formed a deputation from amongst themselves, to visit the different lines in the north of England, the counties of Northumberland and Durham being the only districts where the different systems of power were practised to any appreciable extent. It would appear that, notwithstanding the inspection by the deputation, they were yet unable to decide; and the only conclusion at which they arrived was, that owing to the great traffic anticipated on the new line, it would be impossible to work it by horses. This confined the question within narrower limits, locomotive and stationary engine power being the only systems available for choice.

To set the question at rest, two practical engineers were appointed to visit the Stockton and Darlington and Newcastle lines, and to report thereon. The engineers chosen were Mr. Rastrick of Stourbridge, and Mr. Walker of Limehouse, who accordingly made a joint report on the subject in March, 1829.

After the conclusion of their investigations, and previous to the issue of their report, these gentlemen made application to Mr. Hackworth for particulars of the expenses connected with the maintenance of the locomotive engines on the Darlington line, and when the report appeared, it contained their well-known decision in favor of stationary power.

Mr. Robert Stephenson was at this time carefully searching for evidence to support him in his opinion in favor of the locomotive system, in opposition to the report. A letter from him to Mr. Hackworth, dated March 17, 1829, refers particularly to this question:—

"The reports of the engineers who visited the north, to ascertain the relative merits of the two systems of steam machinery now employed on railways, have come to conclusions in favor of stationary engines. They have increased the performance of fixed engines beyond what practice will bear out, and, I regret to say, they have depreciated the locomotive engines below what experience has taught us. I will not say whether these results have arisen from prejudice or want of information or practice on the subject. This is not a point which I will presume to discuss. I write now to obtain answers to some questions on which I think they have not given full information. Some of their calculations are also at variance with experiments that have come under your daily observation. For in-

stance, they state it positively as their opinion, that a locomotive engine of 10 horse power, or say, of the usual size, will not convey more than 10 tons, exclusive of the wagons, at the rate of 10 miles per hour in winter-time, and in summer the same engine will take 13½ tons. The calculation is made on the assumption of the road being level. In answer to this statement, will you be kind enough to state at what speed your own engine returns from Stockton with a given number of empty wagons, and the rates of ascent? The whole ascent will do to get an average. State also at what speed the six-wheeled engine made by R. S. & Co. will return with any given number of wagons. What load, including wagons, will an engine, weighing 9 tons, including water, take at the rate of 10 miles an hour on a level well-conditioned railway? Let it be understood that all your statements are made under the supposition that the speed is to be maintained for 20 or 30 miles without stopping, except for water. Let me have your general opinion as to the locomotive engine system. Is it as convenient as any other? Would you consider 13½ tons in summer, and 10 tons in winter, a fair performance for a good locomotive engine? You will oblige me much by answering the above questions as promptly as possible, as the discussion on the merits of the two systems is yet going on amongst the directors here."

The reply to the above letter, in answer to the several questions propounded, was the following:—

"The statement you allude to, that a complete locomotive will take but 10 tons at 10 miles per hour, is quite at variance with facts: as an opinion merely, this I would forgive. Four of our wagons, laden for depôts, frequently take from 12 to 13 tons of coals, exclusive of the wagons. Our engines never take less than 16 laden wagons in winter, and in summer from 20 to 24 and 32 laden, and can maintain a speed of 5 miles per hour, except in case of stoppages by means of horse wagons at the passing places. Engines thus loaded have frequently traveled at 9 miles per hour, sometimes more. It is unsafe to aim at speed upon a single line of railway, the danger is at the passing places. I am verily convinced that a swift engine, upon a well-conditioned railway, will combine profit and simplicity, and will afford such facility as has not been hitherto known.

"I am well satisfied that an engine of the weight you mention, will convey, on a level, in winter, 30 tons of goods, 10 miles per hour, exclusive of carriages, and 40 tons in summer, exclusive of carriages. The six-wheeled engine fitted up at the Company's works, generally takes 24 wagons, 53 cwt. to 3 tons of coals each, speed 5 miles per hour, empty wagons 24 cwt. each. The six wheels by R. Stephenson & Co.,—20 wagons, 5 miles per hour, weight as above.

"As to my general opinion as to the locomotive system, I believe it is comparatively in a state of infancy. Swift engines upon a double way, I am convinced, may be used to the utmost advantage. Improvements upon anything yet produced, of greater importance in all respects, are clearly practicable; and I am sure this will prove itself by actual remuneration to such parties as prudently, yet diligently, pursue the execution of this kind of power, with their eyes open to those alterations and advantages which actual demonstration of local circumstances point out.

"Stationary engines are by no means adapted to a public line of railway.

I take here no account of a great waste of capital. But you will fail in proving to the satisfaction of any one, not conversant with these subjects, the inexpediency of such a system. It never can do for coaching; passengers cannot be accommodated. If endless ropes are used, there will be both danger and delay. What provision can be made to answer the stretching of ropes? I have known a rope a mile and a quarter long, stretch 70 fathoms in one day. What set of apparatus will be found practically applicable to give the rope proper tension? Admit it to be possible, who would dare to be near when a mass of matter standing at rest, say 20 to 30 tons, is first put in motion by a rope moving at the rate of 10 to 15 miles per hour? It need not be added what will follow—a scene of endless confusion!

"I hear the Liverpool Company have concluded to use fixed engines. Some will look on with surprise; but as you can well afford it, it is all for the good of the science and of the trade to try both plans. Do not discompose yourself, my dear sir; if you express your manly, firm, decided opinion, you have done your part as their adviser. And if it happen to be read some day in the newspapers—'Whereas the Liverpool and Manchester Railway has been strangled by ropes,' we shall not accuse you of guilt in being accessory either before or after the fact."

To be continued.

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*Floating Caisson Gate at Plymouth Dockyard.**

We gave some time ago (Vol. XLIX, p. 441) a description of the floating caisson gate designed by Sir Samuel Bentham for the Great Basin at Portsmouth, and erected under his immediate superintendence. A similar work has just been completed for the new works at Keyham, (connected with the Plymouth yard,) by Messrs. William Fairbairn & Sons, of Manchester. We extract the following account of it from a local paper:

"The caisson is a huge hollow iron box of the form of the entrance to the lock, perfectly flat at the sides, 82 feet 6 inches long at the top, only 13 feet 6 inches wide, and of the enormous depth or height of 42 feet. The lower part of this box is formed into an air chamber, or what may be termed the lungs of the caisson, by a strong iron deck which is carried from side to side at a height of about 12 feet from the bottom, and made perfectly air-tight. The capacity of this air chamber is so adjusted that when the caisson is immersed in water, the confined air exerts a buoyancy a little in excess of the total weight of the caisson; and as, by means of sluice valves, the water is allowed to enter the inside of the caisson, and fill it from the top deck of the air chamber upwards to the level of the water outside, whatever that may be, it follows that at any point of the tide, and with any depth of water greater than that which would float it, the caisson would swim a few inches clear of the masonry. The total depth of the caisson is about 5 feet greater than the depth of the water at the entrance to the lock at high spring tide, and this space is made available for the means employed for sinking and moving the caisson. A watertight tank is formed in this part of the caisson, capable of holding 60 to 70

* From the London Mechanics' Magazine, for July, 1850.

tons of water, supplied to it from the water main of the dockyard; and it depends upon the presence or absence of this quantity of water in the upper tank whether the caisson remains firmly resting on the masonry, and closing completely the entrance to the lock, or floats a few inches clear of the floor, ready to be hauled by capstans into the recess in the earthwork which has been prepared."

The ingenious manner in which the buoyant principle is taken advantage of constitutes the most meritorious feature of this scheme, for the emission of the small quantity of water confined in the top tank, (which, by means of an ordinary valve placed in its bottom, is accomplished in about two minutes,) dispenses with the laborious and expensive process of pumping, which has usually to be resorted to.

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*American Engineering—Locomotives.**

Continued from Vol. XIX, page 222.

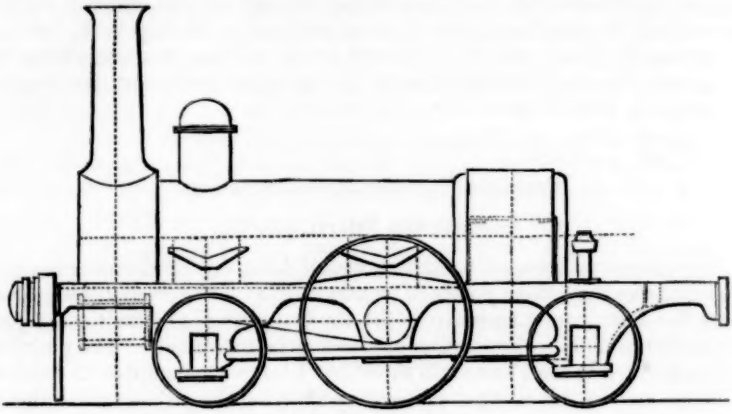
The American locomotive differs widely from the English engine, and both systems have their points of superiority: as far as design goes, I believe the American engine may claim the first place; in execution and proportioning of details, the English engine stands unrivalled. The previous pages devoted to the Frame will show that I intend to compare the various systems; and by this comparison, and by applying the principles and theory of construction, to elucidate that which is good and commendable, and guard against what is bad.

The word "theory" has been often misapplied to investigations apparently scientific; but, in practice, not only utterly useless, but which have even proved, when the test of actual working has been applied to them, erroneous and opposed to facts. Hence the old and oft-repeated saying, "Many things are good in theory, but bad in practice," has received a semblance of truth. But in all such cases we shall find the reasoner to be misled; that he comes to wrong conclusions from correct premises; that he, not science, is wrong. Many wild schemes have been thus pushed forward,—there is the perpetual motion, the inventors of which are blind to the absurdity of creating something everlasting out of decaying materials; the multiplication of power by mechanical movements, whereby a baby is made to do the work of a 100 horse engine, the designers wholly forgetting the effect of friction and weight, and being profoundly ignorant of the fact, that power is gained at the loss of speed, and that the effect of power is the product of speed and power. There was the hydraulic railway, and the compressed air railway, in which, at certain points on the road, the boiler or reservoir, (being divided into air-tight partitions,) was to be inflated with air at an immense pressure; the use of the partitions being to prevent the two rapid diminution of pressure, and to keep always on hand some air of real high pressure. In the same proportion in which railroads have taken hold of public attention, have dreamy schemers tried to introduce impossible projects, and have caught hold of shadowy schemes, by which to attain all imaginable but impracticable ends. Such would-be inventors reason wrongly, because they do not admit into their calculations

* From the Glasgow Practical Mechanic's Journal, for May, 1850.

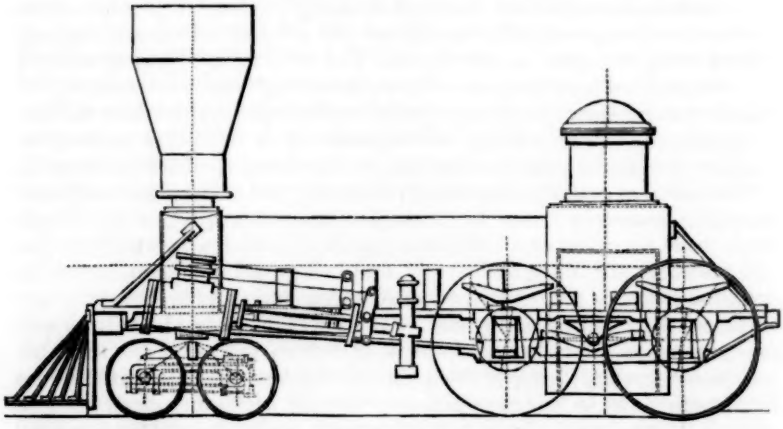
such facts, and principles which are proved by facts, as bear upon their case, either because they are ignorant of them, or because they are too infatuated on the score of their own cleverness. In either case, they are not fitted to work out a practical design, and the name of theory applied to their calculations is a misnomer.

ENGLISH OUTSIDE-CYLINDER LOCOMOTIVE.—No. 1.



1-6 inch = 1 foot.

AMERICAN OUTSIDE-CYLINDER LOCOMOTIVE.—No. 2.



1-6 inch = 1 foot.

True theory cannot be wrong, and its application to manufactures or general practice can never lead to error. For what is theory? It is the generalization of the results of experience to simple expressions, which greatly facilitate the use of former experiences in new designs. Experiment has proved the pressure of the atmosphere to average 15 lbs. to the

square inch. Experiment has shown this pressure to be exerted equally in all directions. These are first principles. Arithmetical calculation being brought to bear upon them, a theory is the result, by which, for instance, an engineer calculates the area of his safety-valve. Had he no such theory, or no such generalized expression for facts, the safety-valve in every case would be constructed by guesswork, and, to test its accuracy, he would have to create a vacuum above it, raise steam in the boiler, and load the valve by means of scales, then attach his levers and weigh them till the same balance was produced. After a few such trials he would come to general results, by which he would act in future cases. That would then be his theory; but to make these experiments much science is required. Scientific men have made them, and practical men make use of their deductions—of their theories. A body heavier than water, sinks in it; one lighter than water, floats. Fluids contained in vessels of unequal size, connected at the bottom by a narrow tube, balance each other. A small power exerted at the long end of a lever overcomes a large resistance at the short end. These are called principles, or laws of nature, because in every case they hold good. Such principles, with many others, led to the construction of the hydrostatic press. Other principles were admitted into the calculation, new ones were observed, and the theory was raised by which these presses are now made of such perfection and strength. Many a mechanic uses them and makes them, and laughs at the idea that there is theory in their construction. The combination of principles forms a theory; theories classified into systems form sciences. Sciences, which—though to the unlearned are without apparent connexion—are founded upon the same elementary principles—form branches of philosophy, such as astronomy, optics, mechanics, meteorology,—all are branches of one great natural philosophy.

Every observant man has his own theory—he has derived it from his experiences through life. But if his theories are to be correct, they must be based upon correct observations, upon true—not fanciful or made-for-the-purpose—principles; and his mode of generalizing and thinking must be sound. He must have what is usually called a clear head. Two men observe that beams of various cross sections support various weights. They have to construct new ones for some purpose. They calculate the cross section according to former experience. One lays his beam on the flat side, and it breaks; the other lays it on edge, and it does not break. The calculations of both are based upon the same principles. The one, observing all facts, had formed a theory; the other had observed only half the facts, and therefore his deductions were only half a theory. Failing in practice is not a proof that one fact is worth a dozen theories, but is only a proof that the man's mode of reasoning was deficient and practically bad.

Some men have an intuitive perception of mechanical principles. Theories, which others have to acquire by study, seem to form a part of their mental organization. This we call talent. Talent is ever active—always designs. Such talent carefully cultivated, its possessors become leading men, the main props of their profession; Watt, Smeaton, Brindley, Telford, the late G. Stephenson, I. K. Brunel, Rennie, W. Fairbairn, and R. Roberts, are such men.

Let not practical men, then, turn away from my remarks, when I say I shall apply the theory of construction to the building of locomotives. Where there is no opportunity for trying experiments, reasoning must supply their place, and, if based on sound principles, must lead to the same results. In giving an opinion on an engine, I am not guided by the builder's opinion; if so, I should be led to consider every engine perfect;—but I watch them on the road and in the repairing shop, and inquire among superintendents, drivers, and workmen. My views for rendering an outside-cylinder engine steady at high speeds I stated in a former place; up to that time, the only engines of that class with which I was acquainted were English, or more or less copies from the English style. By observing them, and by reasoning, I came to certain conclusions, which, not having been tried, existed simply as theories. Arriving here, I found that experiments had been made, and such engines had been built, which were remarkably steady. My theory was, therefore, proved correct. The same results had been obtained in different countries, by different modes of handling the subject.

We find another peculiarity in all American engines, introduced as an experiment, found successful, and now universally applied. I believe it need only be known to be generally employed on all locomotives. Wherever stationary force-pumps are used, wherever a strong continuous stream of water is required, chiefly in fire-engines, which are nothing but locomotive—or loco-motive—force-pumps, this end is obtained by the use of an air-vessel. It is the simplest, most economical, and a never-failing plan; and, as far as I can ascertain, was first applied to locomotives here about five years ago, and by the same engineer whose name has before been mentioned—Mr. M'Queen. The locomotive pump consists of two pumps: one a sucking, the other a force-pump. The air-vessel is used either above the lower, or between the lower and the check-valve. Sometimes only one is used, sometimes two. It makes the pumps more efficient, and less liable to failure, in action. In the general employment of a separate cut-off or expansion valve, the American engine also differs from that of English construction. So far as I was acquainted with the continental engines of Europe, a second valve was there always used, the link motion being employed merely for reversing. Of the superior advantages of this arrangement I hope to be able to give a convincing proof.

To be Continued.

AMERICAN PATENTS.

List of American Patents which issued from August 13th to September 10th, (inclusive,) 1850, with Exemplifications by Charles M. Keller, *late Chief Examiner of Patents in the U. S. Patent Office.*

AUGUST.

16. For an *Improvement in Friction Clutches;* Nelson Barlow, St. Louis, Missouri, August 13.

Claim.—"What I claim as new, is the sliding collar connected to, and in combination with, the nut, substantially in the manner and for the purposes specified."

17. For an *Improvement in Cylinder Printing Presses;* Bartholomew Beniowski, London, England, August 13; anté dated October 14, 1847.

The patentee says,—"The principle feature of novelty consists in securing the type or blocks to the inner or concave surface of a cylinder, in place of the outer circumference, as has hitherto always been done. By this arrangement, the centrifugal force developed during the rapid rotation of the large cylinder has the effect of retaining my types in their proper places, rather than of deranging them, as was formerly the case.

"The second part of my invention relates to an improved method of constructing or making the inking rollers or balls used in letter-press or block printing. By my improvement I make the rollers or balls much lighter, cheaper, and more durable and permanently elastic, than the ordinary balls and rollers. To effect this, I substitute for the usual composition either India rubber or gutta percha; I make them also of some air-tight substance, which I fill with compressed air. Many substances may be used for this purpose, such as gut, bladders, impervious cloth, or sheet India rubber;—I prefer this last."

Claim.—"What I consider to be new, and therefore wish to claim, is constructing a printing machine, in which the form or forms of types or blocks are placed on, or secured to, the inner or concave surface of a cylinder or drum, which is made to revolve and carry the form or forms secured thereto from the inking rollers to the printing or impression cylinders, all of which parts are mounted inside the cylinder or drum.

"2d, I claim the methods above shown and described, of making the inking rollers or balls of printing presses or machines."

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18. For an *Improvement in the Manufacture of Candles;* A. B. Warner and J. G. Davis, assignees of James G. Davis, Buffalo, New York, August 13.

The patentee says,—"My machine consists of a cylinder fitted with a piston, by means of which the fatty material of which the candles are made is forced through a cylindrical tube in the centre of which the wick is fed; as the cylinder issues from the tube it is received upon a carriage, furnished at the extremity nearer the end of the tube with a set of knives; as the issuing cylinder strikes the further extremity of the carriage, these knives sever the piece laying upon it from the continuous cylinder issuing from the tube, and at the same time remove the fatty material from a portion of the wick, leaving the latter bare. The candle being thus finished, is thrown off from the carriage, and the latter being returned by a weight or otherwise to its first position, again receives the cylinder issuing from the tube to form a second candle."

Claim.—"What I claim as new, is the arrangement and manner of operating the knives, by which the cylinder of fat, with its central wick, is cut into suitable lengths for candles, and the fat removed from the end of the wick

"I also claim the device for regulating the length, and delivering the candles, substantially as herein described."

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19. For an *Improvement in Instruments for Vaccinating;* Junius F. Tozer, Rochester, New York, August 13.

Claim.—"What I claim as my invention, is the sliding cylinder, in combination with the thumb key, spring, and piston, for the purposes described."

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20. For an *Improvement in Splints for Fractures;* Adam Hays, Madison, Jefferson county, Indiana, August 13.

The patentee says,—"The nature of my invention is such as to enable the surgeon to keep up permanent extension and counter extension throughout the treatment necessary, so as to keep the parts in their proper relative position, and at the same time afford opportunity for dressing as often as may be necessary, without risking any displacement of parts, and thus accomplish a most important object in the management of such cases."

Claim.—"What I claim as my invention, is the cutting out a portion of the splint, to afford an opportunity for dressing as often as may be necessary, the upper and lower portions of the splint being kept firmly united by means of the brace, so as, by extensions and counter extensions, to keep throughout the treatment the proper relative position of the parts concerned, the slide being replaced after each dressing; or any other device substantially the same."

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21. For an *Improvement in Weighing Machines;* George Houston, Washington, Beaufort county, North Carolina, August 13.

Claim.—"What I claim as my invention, is the iron frame, together with the skids and regulating screw used in combination with a weighing beam, as described."

22. For an *Improvement in Packing Journal Boxes and Axles;* Wm. H. Hovey, Hartford, Connecticut, August 13.

"The nature of my improvement consists in the application to the inside of the journal box of a metallic packing ring, fitting accurately to the axle or shaft close to the journal, and acted upon by springs in such a manner as to keep it (the ring) fitting to the shaft notwithstanding the wear by friction, and to force it up to the face of the inside of the box, so as to form a tight joint, which will prevent the escape of the oil or other lubricating material from the box, and will exclude dust, dirt, &c., from the bearing."

Claim.—"What I claim as new, is the combination of the metallic packing ring, having its outer periphery of conical form, the arched springs, having their ends inclined to fit the said ring, and the regulating screws, with the journal box and the axle, in the manner and for the purposes substantially as described."

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23. For an *Improvement in Pentographs;* Allen Judd, Chicopee, Hampden county, Massachusetts, August 13.

"The nature of my invention consists in connecting a pencil with an eye-tube or telescope, so that they shall move in all directions parallel with each other, by means of which any object, over the outline of which the telescope is directed, will be traced on a paper placed before the pencil."

Claim.—"What I claim as new, is the instrument constructed and arranged as above set forth, consisting of a pencil, moving parallel with the eye-tube with which it is connected, as herein described, and marking on a vertical plane, or a plane parallel with their axes of horizontal motion, such objects as the sight through the eye-tube passes over."

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24. For an *Improvement in Bench Hooks;* W. B. Kean, Worcester, Massachusetts, August 13.

"The nature of my invention consists in a spindle provided with a head, having four or any other suitable number of edges passing through a hollow metal socket secured to the bench, in a position slightly deviating from a line perpendicular to the surface of the bench; the lower part of the spindle is screwed and fits into a female screw in the lower part of the socket, the upper part of which fits in a cylindrical guide in the upper part of the socket; the four edges of the head are formed to suit various descriptions of work, and under each edge in the part of the spindle above the screw, is a groove into which a spring catch attached inside the socket fits. The head may be adjusted by the screw on the spindle at any height, and either edge may be set to the work, being secured in any position by the spring catch; the front edge will, owing to the inclined position of the socket, always be highest, and the back edge always lower, so as to be clear of the work."

Claim.—"What I claim as new, is forming the head with any suitable number of edges, of any required form, to suit various kinds of work, and having the spindle, of which the head forms part, grooved and fitted in a socket set at an inclination to the bench, so that any edge of the head can be set to the work, and secured by a spring catch, and whatever edge is turned to the work will be higher than the back or opposite edge, as herein set forth."

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25. For *Improvements in Apparatus for Regulating the Setting of Bows in Wagon Tops;* A. M'Kinney, Montgomery, Orange county, New York, August 13.

"The nature of my invention consists in a frame provided with certain adjustable rules and hold-fast bolts; the frame is intended to be secured to the seat of the wagon; the hoops are set at the required height and distance from each other, plumbed and squared by the adjustable rules, and held by the hold fast bolts until they can be secured to the body of the wagon."

Claim.—"What I claim as new, is the combination and arrangement of the rules, the rods, the pins, the adjusting screws, and the hold-fast bolts, arranged and adjusted upon a frame, in the manner and for the purposes substantially as herein described.

"And I also claim the adjustable rule sliding in the swinging bar, and attached to the same frame with the before described combination, in the manner and for the purposes herein set forth."

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26. For an *Improvement in Ornamenting Textile Fabrics;* Robert Milligan, Harden, England, August 13; anté dated March 18, 1850.

Claim.—"What I claim as my improvement, is the new or improved ornamental fabric or manufacture, made substantially as specified, viz., having any ground suitable or unsuita-

ble for receiving and exhibiting bright color or colors when imprinted thereon, and having figures, stripes, or other portions of surface floated over the said ground in material and color suitable for representing such bright color or colors, and having such bright color or colors printed on the said floated surfaces."

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27. For an *Improvement in Piano Fortes;* James Pirsson, City of New York, August 13.

"The nature of my invention consists in certain improvements in piano fortes, said improvements having for their object the increase of the power of the instrument, both as to sound and the number of performers who may jointly operate upon it. The general arrangement and principle involved is uniting in one case two sets of grand actions, operating upon strings combined so that the vibrations shall be produced upon one general sounding-board, whereby the surface of vibration is greatly extended, as, within proper limits, the larger the sounding-board the greater will be the depth and volume of sound produced."

Claim.—"What I claim as of my own invention, is combining two sets of strings, operated by separate actions, with one and the same sounding-board, whereby I am enabled to produce greater effects, both in quality of tone and in power, than heretofore, and also to maintain the unison of the notes, and the tone, to a degree not possible before; the whole being constructed and operated substantially in the manner described herein."

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28. For an *Improvement in Ship Ventilators;* Warren Robinson, Lebanon, New London county, Connecticut, August 13.

"The nature of my invention consists in placing a number of tubes or other air ducts along the inside of the hull of a vessel in a vertical position, running from that part of the vessel which it is proposed to ventilate up to the bulwarks above the upper deck, and there discharging into a chamber, said chamber being so arranged with a register and valves that a free egress and ingress of air is permitted, while at the same time the water is effectually excluded."

Claim.—"I claim, 1st, the ventilating chamber constructed in the manner substantially as above described, having a tube or air passage communicating with the cabin or 'between decks' of a ship or other vessel, and provided with a register, either for the purpose of admitting pure air by long tubes to the lower parts of cabins or 'between decks,' or for carrying off the ventilated air by short tubes from their upper parts.

"2d, I do not claim the use of a float-valve in the ventilating tube, irrespective of the manner of applying them, but I claim having the two float-valves attached together in the manner substantially as described, and each acting independently of the other, upon a separate seat in the ventilating chamber, so that any water passing one valve may be shut off by the other."

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29. For a *Safety Apparatus for Steam Boilers;* John C. Tennent and John Workman, Philadelphia, Pennsylvania, August 13.

Claim.—"What we claim as our invention, is the application of a rope made of any combustible material, (using for this purpose wool, as prepared in the manner before noticed, or any other material which will answer the intended effect,) to the upper surfaces of one or more tubes or flues of a boiler, which, when said tubes or flues are uncovered of water, will burn off or part in the manner as before described, for the action of the excessively heated metal and surcharged steam, which the rope is connected with, and by its parting actuates the apparatus herein described, or any part thereof, for the purpose either of giving alarm, or putting in action means of safety, or both, substantially as herein described."

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30. For *Improved Serving Mallets;* Thomas Batty, City of New York, August 20.

"The nature of my invention consists in the attachment of a series of grooved friction rollers around that part of the head of the serving mallet on which the spun yarn is wound, the grooves in the rollers being to guide the spun yarn; the object of the rollers is to reduce the immense friction which renders the use of the ordinary serving mallet so extremely laborious, and wears out the mallet so quickly.

"It further consists in making the groove in the face of the mallet deeper at the end which covers the served part of the rope, so as to give the mallet an even bearing, and make it finish the work more closely."

Claim.—"What I claim as my invention, is, 1st, attaching friction rollers to the periphery of a serving mallet, substantially in the manner and for the purposes herein described.

"2d, Making the groove or face deeper or larger at the part which fits the served part of the rope, in the manner and for the purposes substantially as herein described."

31. For *Improvements in Gun Harpoons and Lances;* Robert Brown, New London, Connecticut, August 20.

"My invention and improvement consists, 1st, in attaching a tail of short cords, or their equivalents, to the butts of gun lances in such manner that the cords can be laid by the side of the shank, loaded with it into the gun, and fired therefrom; the tail thus arranged will, during the flight of the lance, be extended behind it, and operate as a drag on its butt end, keeping the latter back and the point forward, thereby rendering its flight in the direction in which it is aimed more certain.

"Experiments have shown that the shoe or button at the butt end of harpoons and lances prevents the lines attached thereto from trailing, during their flight, as nearly in a line with the shank as they would if left free to assume their positions without obstruction from the button; and likewise, that these buttons greatly retard the flight of the harpoon or lance, by the great area which they oppose to the action of the air.

"The object of the second part of my invention is to remedy these defects, and it consists in making the button separate from the shank, and so attaching it thereto that it shall fall therefrom very soon after the lance leaves the muzzle of the gun."

Claim.—"What I claim as my invention, is attaching a tail or cords, or their equivalents, to gun lances, substantially in the manner and for the purpose herein set forth.

"I also claim attaching the button to the shank of gun harpoons or lances, in such manner that when the lance or harpoon is discharged from the gun the button will drop off, being thereby prevented from retarding the flight, and from deflecting the lance or harpoon from the line in which it is projected from the gun, substantially as described."

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32. For an *Improvement in Obstetrical Supporters;* Francis S. Chase, Clintonville, and Adam Weston and Leander Babbitt, Au Sable, Clinton county, New York, August 20.

"The nature of our invention consists in the combination and arrangement of an instrument denominated an 'obstetrical supporter and assistant,' designed to support and relieve a woman during parturition; and render delivery easier, more speedy, and safer, being so constructed as to adjust perfectly to the body and limbs, and protect the os coxix from all pressure of the fœtus, and thereby enlarge the measurement of the pube coxigeal space, secure to the patient a pliant and comfortable seat and posture, support and comfort to the back, the sacrum and the hips, and prevent those distressing pains of the thighs, which frequently occur in delivery under ordinary treatment."

Claim.—"What we claim as new, is the combination in the manner described, of the sliding plate with the back pad which is connected to the seat, for the purpose of enabling the bearing of the instrument to be moved higher up or lower down the back, without disturbing the patient."

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33. For a *Method of Propelling Boats in Shallow Water;* John Dougherty, Mount Union, Huntingdon county, Pennsylvania, August 20.

Claim.—"What I claim as new, is, 1st, the combination and arrangement of the setting pole, sliding in the sheath, with the spring bolt and cords, for the purpose of shortening or lengthening the setting pole, substantially as described.

"2d, The manner described of checking or snubbing the boat, by means of a chain or cord attached to the foot of the setting pole, and passing over pullies to a windlass placed in the stern of the boat, near to the helm, as described."

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34. For an *Improvement in Compound Wagon Boxes;* Imla Drake, Mansfield, Warren county, New Jersey, August 20.

"My invention consists in the application of jointed screw bolts of adequate strength, attached by eyes, hooks, or any other convenient and equivalent device, to the axles, frame, or other solid parts of the vehicle, and capable of being laid down or set up at pleasure, and of such length as, when standing erect, to extend above the top of any load intended to be carried, and combined with the parts hereinafter mentioned."

Claim.—"What I claim as my invention, is making the fastenings of a compound wagon body, by combining with screw bolts, so jointed to the axles, frame, or body of the carriage as to be laid down or set up at pleasure, two cross pieces to each pair of bolts, with pressure nuts above the upper, and sustaining nuts beneath the lower, cross bar, whereby the whole load may readily and easily be secured, or the lower part may be released and withdrawn, without disturbing that which is above it, substantially as herein set forth."

35. For an *Improved Steam Boiler;* Richard E. Dibble, City of New York, August 20; anté dated July 20.

"The object of my invention is to maintain a constant and rapid circulation of the water in a tubular steam boiler, through the tubes and through a series of water vessels, which depend from the roof of the fire box, and expose a very large surface to the direct action of the fire."

Claim.—"What I claim as my invention, is the arrangement of pendent water vessels in the fire box, in combination with water tubes which pass along the flue, and are connected at one extremity with a water space near the back of the boiler, and at the other with the water vessels at the fire box, substantially as herein set forth."

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36. For an *Improvement in Changing Rotary Motion into Reciprocating Motion;* Isaac D. Garlick, Lyons, Wayne county, New York, August 20.

Claim.—"What I claim as my invention, is the mechanical arrangement and combination of parts by which I convert the rotary motion of the wheel into a reciprocating movement of the churn dasher-rod, to wit: by means of the action of the lugs, that project from the face of the said wheel, upon the forked rocker and the vibrating beam, when aided by the inclined planes, substantially in the manner set forth."

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37. For an *Improvement in Machines for Cutting Hemp;* J. Locke Hardeman, Arrow Rock, Saline county, Missouri, August 20.

"The nature of my invention consists in the construction of a machine by which the hemp is cut and deposited in bunches, out of the way of the succeeding course of the team of horses by which it is drawn, and the track of the machine."

Claim.—"What I claim as my invention, is the attaching a series of blades upon an arm back to back, in a V-form, their edges elevated in order to give a smooth glancing stroke upward through the stalk of hemp, after the manner of the cutting performed by the common scythe in hemp or grain.

"I also claim the introduction and use of a cleaning shear over the crotchet or junction of the blades, to remove such hemp as may be imperfectly cut or pulled up, substantially in the manner as set forth.

"I claim the method of separating and bunching the hemp after it has been cut, by means of a wedge or inclined plane, and a revolving cone.

"I claim the invention and use of the revolving rack as a substitute for the over-head reel, in supporting the hemp while being cut."

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38. For an *Improvement in Fulling Mills;* John C. Millar, Springfield, Hampden county, Massachusetts, August 20.

"The nature of my invention consists in running a horizontal wheel, with buckets or ribs on its outer face, within a tub or cistern, said cistern also having buckets or ribs projecting from its inner face towards the centre wheel, as seen in the drawing, leaving, however, a space between, for the cloth to roll in a mass as the wheel turns. The improvement made is in avoiding all rubbing friction, and consequestly all wear of the fabric, in the process of fulling or washing; this is readily demonstrated by turning the wheel with a bit of cloth or paper placed in the tub."

Claim.—"What I claim as my invention, is so arranging a vertical fluted or ribbed cylinder, and fluted or ribbed concave, that the rotation of the former on its axis shall cause the goods to be fulled to assume a cylindrical form, and to rotate on its own axis, by means of the friction of the two fluted or ribbed surfaces acting upon, and sustaining in its position, the cloth or goods, as set forth."

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39. For an *Improvement in Machines for Cutting Crackers;* William R. Nevins, City of New York, August 20.

"The nature of my invention consists in giving the rollers a constant velocity, and adjusting the number of strokes of the cutters thereto; and also in adjusting the feed of the apron to the number of strokes of the cutters."

Claim.—"I claim the combination of the three following elements, viz., 1st, the constant velocity of the breaking rollers.

"2d, The number of strokes of the cutters adjustable thereto, by means substantially as de-

scribed, so that, within certain limits, they may be varied in relation to the number of revolutions of the feed rollers.

"3d, An adjustable feed to the apron, derived from the shaft carrying the cutters, so that it always makes the same number of strokes, but each stroke may be varied in length, by which, in the same machine, I am enabled to cut crackers of any given size."

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40. For an *Improvement in Preparing the Face of Metallic Types, Engraved Plates, &c.;* Luke Vanderveer Newton, City of New York, August 20.

"The nature of my discovery consists in a new method of coating the wearing surfaces of ordinary printing types, stereotype plates, and other plates, whether engraved or cast, so as greatly to prolong the wear of said types and plates in the process of printing or taking impressions from them. This object I attain by plating the surface of the type, stereotype plate, picture cut, or other device, on those parts which are subject to the action of the printing press, with a metal more durable than the type, plate, &c., is itself composed of; and the means I employ to effect this is galvanic electricity."

Claim.—"What I claim as my invention and discovery, is the plating or coating of the surfaces of metallic printing types, stereotype plates, or other printing plates, whether cast or engraved, with an additional coat of metal, by means of galvanic electricity, in the manner and for the purpose described."

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41. For an *Improvement in Hot Air Registers;* George Pollock, Roxbury, Norfolk county, Massachusetts, August 20.

Claim.—"What I claim as new, is the method of moving the dampers in registers or ventilators, by means of the slider and the oblique bars, with their several forms and parts, substantially as described, in combination with the oblong dampers hung in the middle of their width, in the manner and for the purposes herein set forth."

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42. For a *Register for Steam Boilers;* Jas. D. Rice, Philadelphia, Pennsylvania, August 20.

"The nature of my invention consists in connecting a registering apparatus, combined with a steam pressure gauge and water line gauge, to the gauge line of steam boilers, in such manner as, by opening and closing the gauge cocks, the pressure of steam and the height of water of steam boilers, and also the intervals of time elapsing between trying the gauge cocks, shall be registered upon paper or other suitable material."

Claim.—"What I claim as my invention, is connecting the gauge rods with the gauge cocks in such manner, as herein described, that the pressure of steam and height of water shall be registered each time the gauge cocks are tried, the register indicating at the same time the period of time of trying the gauge cocks by opening and closing them."

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43. For a *Machine for Cutting Sheet Metal, &c.;* Stephen P. Ruggles, Boston, Massachusetts, August 20.

Claim.—"What I claim as my invention, is the toothed rack or its equivalent, applied to the bar, and a system of one or more gears, or the mechanical equivalents thereof, applied to the cutter wheel, and made to engage with the said racks or equivalents therefor, in combination with the said bar, the cutter wheel and its sliding carriage; the same being substantially in the manner as above described, and for the purpose of causing the cutting periphery of the rotary knife to travel around faster than the knife moves horizontally, and thereby to make said knife cut with a drawing stroke.

"I also claim the combination of the swinging frame and gauge contrivance, or equivalents therefor, with a sliding carriage, its cutter wheel, and the slide bar and straight cutting edge, as substantially specified; the same being for the purpose of enabling me to cut either circular or curved work, as described, and of any diameter or dimensions capable of being produced by the machine, of whatever size it may be made."

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44. For an *Improved Opening and Closing Bucket for Paddle Wheels,* George Tingle, City of New York, August 20.

"The nature of my invention consists in certain improvements in the propelling wheels for steam vessels, the said improvements having for their object the production of a better action of the floats or buckets upon the water than the old modes, in order that the angular action of said floats may be measurably overcome, and all jar, shocks, and undue commo-

tion in the water be avoided, as well as that the ability to give a greater depth or immersion to the said floats may be obtained, and thereby secure a greater hold upon the water."

Claim.—"What I claim as of my own invention, is, 1st, the formation of each of the blades composing the bucket so that their inner or closing ends shall be heavier than the outer ends thereof, when combined with a stop or stops, substantially as herein described, thus effecting the closing together of the same by the action of gravity before entering the water, as set forth.

"And 2d, I claim curving the inner edges, so as to insure the closing of said edges together by the action of the water while backing, and thus complete a sufficient bucket for that purpose, substantially in the manner described herein."

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45. For *Improvements in Machines for Heading Bolts, Rivets, &c.;* John Van Brocklin, Middleport, Niagara county, New York, August 20.

"The nature of my invention and improvement consists in forming in the lower portion of a box or holder of a hand lever, a flaring or bell-mouthed cavity, for the purpose of embracing the upper tapered ends of the dies when the hand lever is down or nearly in a horizontal position, and the movable jaw closed by a cam lever, by which the dies are clamped firmly together during the operation of heading the bolt, while at the same time the ends of the dies act as a guide, to cause the holding and heading box to assume its proper position before the descent of the piston header or swage, and prevent the metal being forced out between the top joints of the dies and bottom of the cavity during the operation; the heading of the bolt being effected by means of a swage or piston header, made to descend by the action of a sledge or hammer, which expands the end of the bolt laterally in the lower portion of the opening in which the piston header moves, and thus forms the head of the bolt between it and the ends of the dies; the size of said opening in which the piston moves governing the lateral expansion of the metal, and hence the size of the bolt-head. The bolts being headed, the hand lever is raised to a vertical position, and the movable jaw opened by the cam lever, and the headed bolt or bolts discharged from between the dies."

Claim.—"What I claim as my invention, is attaching to, or forming in, the lower part of the box or holder a flaring or bell-mouthed cavity, which embraces the tapered ends of the dies when the box is down or in a vertical position, and clamps them firmly together, while at the same time the cavity acts as a guide to cause the heading box to assume its proper position, and prevents the metal from being forced out between the ends of the dies and bottom of the cavity in the box during the operation of heading."

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46. For an *Improved Method of Carrying Vessels over Shoals;* J. A. Winslow, Roxbury, Norfolk county, Massachusetts, August 20.

"My invention consists in an improved method of transporting large vessels over bars or shoals, where the depth of water is too small to admit of their passing without lightening or otherwise decreasing the draft, by means of a steam camel tug, which enables the vessel to be taken over the bar partly sustained by her own buoyancy in the water, and only receiving so much assistance from the camel as is necessary to reduce the draft to the depth of water on the bar, at the same time having great facilities for getting the vessel in and out of the camel, and, when in process of transportation, protecting the vessel and apparatus from injury by heavy seas, and giving such speed that the vessel shall not be materially delayed by the operation."

Claim.—"What I claim as new, is the mode or method of transporting a vessel across shoals or bars, by means of a camel having an unyielding platform for the vessel to rest on, and likewise provided with a bow, as herein described, the vessel being partly water-borne and partly supported by the camel."

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47. For an *Improvement in Processes for Making Stannates of Potash or Soda;* James Young, Manchester, England, August 20; anté dated December 9, 1848.

Claim.—"I claim as of my said invention, the mode of producing a stannate of soda by heating a mixture of tin ore and sulphuret of sodium, and a stannate of potash by heating a mixture of tin ore and sulphuret of potassium, and afterwards separating the sulphur from these mixtures respectively by means of a metallic oxide, in the manner described."

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48. For an *Improvement in Expansible Bitts;* Clinton L. Adancourt, Troy, New York, August 27.

"The nature of my invention consists in making expansible bitts for boring conical holes

any given distance into the material, and clip the core, so that it is discharged from the hole without the necessity of boring through the material, making it so that tenons may be firmly wedged into mortises, and the tenon entirely enclosed."

Claim.—"What I claim, is the herein described expansible bitt, in combination with the single or double collar or tube, constructed and operating in the manner substantially the same as herein set forth."

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49. For an *Improvement in Obstetrical Chairs and Supporters;* Asa Blood, Janesville, Rock county, Wisconsin, August 27.

"My invention consists in dividing the seat of the chair into sections, which are hinged together at their hinder extremities in such manner that they can be separated at the front of the seat to form any required angle with each other, and in the several devices connected with the chair, which assist in the process of parturition."

Claim.—"What I claim as my invention, is an obstetric chair with its seat composed of sections hinged together, substantially in the manner and for the purpose herein set forth.

"I also claim a chair-back, hinged to the seat in such manner that it can turn both horizontally and vertically, substantially in the manner herein set forth.

"I likewise claim the combination of the stirrups with the abdominal pad, substantially in the manner and for the purpose herein set forth."

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50. For an *Improvement in Turning Up the Steps of Omnibusses;* Stephen Burdett, City of New York, August 27.

Claim.—"What I claim is the turning up of the step (it being properly prepared for the purpose) by the action of the spiral or other spring upon the stepping off of the passenger, and the withdrawing of the driver's foot, and its connexion with the brake apparatus, thus preventing boys or others from riding on it: the whole being attached to the body of the carriage, and operating substantially as fully set forth."

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51. For an *Improvement in Machines for Cutting Straw;* Harry Camp, Newton, Newton county, Georgia, August 27.

Claim.—"What I claim is, 1st, the manner of hanging the knives to the wheel, as described.

"2d, Forming the knives with a hook-shaped end, in the manner and for the purpose set forth.

"3d, The collar on the projecting end of the mouth-piece, forming a support for the detached end of the knife to rest against, as described."

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52. For an *Improvement in Revolving Coal Grates;* John B. Chollar, West Troy, Albany county, New York, August 27.

"The nature of my invention consists in making the grate hollow in the usual form of a cylinder, the bars surrounding it at an angle of about ten degrees more or less from the right angle with the axis of the cylinder, similar to a screw-thread, each circuit of the thread being disconnected from the next succeeding one, its two ends joining together, and a proper space left between the bars."

Claim.—"What I claim as new, is the manner of arranging bars or flanches around the cylinder, at an angle of any desired degree from the axis of the cylinder, so as to move the coal alternately in opposite directions; the same forming a fire grate, in the manner and for the purpose substantially the same as herein described."

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53. For an *Improvement in Self-Generating Gas Lamps;* Sharpless Clayton and Yarnall Baily, West Chester, Chester county, Pennsylvania, August 27.

"The nature of our invention consists in forming a beautiful gas-light from fluid, by extending a wick through the common fluid lamp tube into a spheroid or other shaped ball or cavity, in which it is coiled, giving an opportunity of generating gas, by means of two or three small jets, from small apertures or holes underneath the ball which are lit in the usual way, by means of heat."

Claim.—"What we claim as our invention, is the extension of the wick into a ball or cavity where the gas may be generated by means of jets, as above set forth."

54. For an *Improvement in Coal Stoves for Roasting, Baking, and Boiling;* Thomas G. Clinton, George H. Knight, and Edward H. Knight, Cincinnati, Ohio, August 27.

Claim.—"What we claim as new, is, 1st, the arrangement after the manner and for the purposes herein described, of a grated or other more or less open fire-back, whereby a roasting surface is presented to the interior of a stove.

"2d, The provision substantially as described of dampers, whereby the roasting surface may be regulated or entirely closed up or opened at pleasure.

"3d, The falling grate, arranged and constructed substantially as described, so as to enable extension horizontally of the body of the fire for a boiling surface.

"4th, The fire door having hopper-sides, and forming, when extended, a canopy for the conduction of effluvia.

"5th, The hopper or funnel-shaped door, as arranged and here applied for the insertion of fuel."

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55. For an *Improved Lock for Fire Arms;* Nathan B. Cook, Chicago, Cook county, Illinois, August 27.

"The nature of my invention consists in the fact that I so construct and arrange the machinery of the lock of a revolving or other fire arm, that, by pressing upon the trigger with the finger, the hammer is brought back to cock, and the finger may then be removed and the trigger allowed to pass forward, while the hammer is retained in its position by the seer, and may then be discharged by a light touch of the finger upon the trigger, enabling the operator to fire with all the ease and steadiness secured by the use of the hair trigger, or admitting of being fired, when expedition is desired, by one continuous pull or pressure of the finger upon the trigger."

Claim.—"What I claim as new, is the seer in combination with the pin and shoulder on the trigger, by which arrangement the hammer, after being brought back by the pressure of the finger upon the trigger, is held in its position by the seer while the trigger passes forward, and the piece is discharged by a light touch of the finger upon the trigger, securing deliberation and certainty of aim, or may be discharged by one continuous pressure of the finger upon the trigger, at the pleasure of the person using the same."

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56. For an *Improvement in Shirt Studs and Buttons;* Benton P. Coston, Philadelphia, Pennsylvania, August 27.

"My said invention consists in making the shank of the stud of a peculiar shape, whereby it is readily attached to, and securely held on, the garment."

Claim.—"What I claim as my invention, is constructing the shanks of shirt studs and buttons, in the manner and for the purpose herein set forth."

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57. For an *Improvement in Stoves with Circular Shaking Grate;* Edward B. Finch, Peekskill, Westchester county, New York, August 27.

"The nature of my invention consists in having the bar which supports the circular rotary or shaking grate, cast with, and forming part of the top plate of the ash box, and in providing a sliding segment for the purpose of closing the slot or aperture in the seat, through which the lever for shaking the grate works."

Claim.—"What I claim as new, is casting the seat of the fire box separate from the top plate of the ash box, having the bar carrying the centre or pin for supporting the grate cast with, and forming part of, the top plate of the ash box, substantially as described and for the purposes set forth."

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58. For an *Improvement in Cast Iron Car Wheels;* Albert Fuller, Boston, Massachusetts, August 27.

Claim.—"What I claim as my invention, is making the two plates which connect the hub and rim of a cast iron railroad wheel in a series of lateral arching sectors, connected by the curved partitions, in the manner and for the purpose specified."

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59. For an *Improvement in Detaching Horses from Carriages;* John W. Harrison, Logansport, Cass county, Indiana, August 27.

Claim.—"What I claim as my invention, is the application to buggies and other vehicles drawn by horses or other draught animals, of a new and useful improvement on the swingle-

tree, which I entitle the safety swingle-tree, together with its apparatus, consisting of a lever and king-bolt, a grooved-headed screw-bolt, a flat-headed screw-bolt, a force spring, and two stirrups, combined as above described, which, upon the king-bolts being raised as above described, will allow the horse to become unhitched, and to pass off freely from the same and every part thereof, without danger to the same or to persons therein contained; using in the construction of the same wrought iron or any other durable material that will insure the desired effect."

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60. For an *Improvement in Grain Dryers;* John R. Hoopes, West Philadelphia, Philadelphia county, Pennsylvania, August 27.

"The nature of my improvements consists in arranging horizontally a series of six or more drying plates, connected with each other by tubes forming passages for the grain, and having flues passing under and above them forming grain chambers; and a vertical shaft passing through the centre of the plates and chambers, (which is made to revolve by a band passing around a pulley at its upper end,) to which is attached a series of arms or flanches, one to each chamber; these curve alternately in opposite directions, producing a centripetal and centrifugal motion to the grain, drawing it through the respective passages leading from each chamber, and keeping it in constant agitation, preventing it from adhering to the plates or burning, as hereafter more fully described."

Claim.—"What I claim as my invention, is the arranging a series of drying plates one above another, connected by passages as described, in combination with the vertical shaft and arms thereon, curving alternately in opposite directions, combined and arranged in the manner and for the purpose set forth."

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61. For an *Improvement in the Mode of Cleansing and Drying Gum Elastic or Cloth Bands in Calico Printing;* Jeremiah Knight, Providence, Rhode Island, assignee of James Hunter, Blockley township, Philadelphia county, Pennsylvania, August 27.

"The nature of my improvement consists in the arrangement of some suitable apparatus, by which the endless gum elastic or vulcanized India rubber or other bands or cloth, after passing through the printing machine, and receiving the surplus coloring matter upon them, are made to pass over rollers and other convenient contrivance revolving in water, and thence between two squeezing rollers, one of which has a doctor or scraper attached to it. The effect is to remove the coloring matter from the cloth, while the rollers and scraper partially dry it and remove from the surface any thread or lint which may still adhere, and the band or blanket, thus cleansed, returns to the printing machine in a condition to perform its portion of the work without imperfection."

Claim.—"I claim as my invention the arrangement of the rollers and vat above described, for washing the India rubber bands, or other endless blankets, used in calico or other printing, said rollers being only partly immersed in water, and other parts being arranged and operated as set forth."

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62. For an *Improvement in Saws;* Hazard Knowles, Washington City, D. C., August 27.

"The nature of my invention consists in the improvement in saw-teeth substantially as represented in the drawings and hereinafter set forth, viz., the cutting edges of the teeth projecting forwards, with an outward inclination from plane or curved surfaces (separated by notches) a distance equal to the thickness or chip that each tooth is intended to remove, which plane or curved surfaces should be on a line, straight or curved, with each other, and parallel, or nearly so, with an imaginary line drawn over and touching the cutting edges of the teeth."

Claim.—"What I claim as my invention, is my improved saw-teeth, constructed and operating substantially as herein described, viz., the cutting edges of the teeth inclining outwards from plane or curved surfaces, a distance equal to the thickness of chip that each tooth is intended to remove from the wood, and being prevented from taking a deeper hold upon the wood, at the same time that they are strengthened by the said outer surfaces, in consequence of these surfaces being in a line with each other, and parallel, or nearly so, with an imaginary right line or circle drawn over and touching the points of the saw-teeth."

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63. For a *Self-Acting Adjustable Feed-Gear for Drilling Machines;* Alden R. Morrill and Hiram Baldwin, Nashua, Hillsborough county, New Hampshire, August 27.

Claim.—"What we claim as our invention, is the combination substantially as described, of the splined screw, the splined shaft, the smooth wheel, the toothed wheel carrying a nut,

the arm, the catch, the small arm, the spring, and the segment, so as to form a self-acting adjustable feed for boring or drilling machines."

64. For a *Method of Attaching Yards to Trusses;* Tilgath Odeon, Portsmouth, Virginia, August 27.

Claim.—"I claim suspending the yard to the truss by means of linked and swiveled eye-bolts, whereby the yard may either be allowed to hang freely below the eye which is swiveled to the truss, or may be slung upward and inward towards the mast, so as to bring its centre above the bowed end of the truss, in the manner and for the purposes herein set forth."

65. For an *Improvement in Electric Telegraph Manipulators;* Austin F. Park, Troy, New York, August 27.

"The nature of my invention consists in arranging machinery for closing and breaking an electric telegraph circuit in transmitting intelligence, whereby the operator, by giving a finger key one instantaneous touch, as distinguished from the prolonged touch applied to the key in ordinary machines, closes and breaks the electric circuit, at and during such time as is required to signal or record a telegraphic sign for a letter, figure, or other character."

Claim.—"What I claim as my invention, is, 1st, the two guides with their hook and detent spring as described, in combination with the movable connecting points and the type forms for letters, substantially in the manner and for the purpose set forth, the guides being disconnected as soon as the movable connecting point has passed them, thereby causing the finger key rods to resume their proper position to be again acted upon, and allowing the succeeding points to pass in their regular revolving course without coming in contact with the type forms.

"2d, I also claim the manner of disconnecting the two guides, viz., by the action of the movable connecting point upon the detent spring, as above described.

"3d, I claim the employment of a clicking apparatus to indicate the proper time of depressing the keys; the whole being constructed and arranged in the manner and for the purpose substantially as herein set forth."

66. For an *Improved Arrangement of Dampers in Cooking Stoves;* Henry L. Sheperd, Dayton, Montgomery county, Ohio, August 27.

"My improvement is for the purpose of more effectually distributing the heat over the surface of the oven and through its interior, especially when a division is introduced horizontally therein. For this purpose I divide my draft and arrange my flues as about to be described; by which arrangement I keep up an active draft, and direct the heat in all directions with equal facility."

Claim.—"What I claim as new, is the vertical dampers placed below the top of the oven in the division partitions, substantially as described."

67. For an *Improvement in Blowers of Franklin Stoves;* W. P. Cresson, assignee of David Stuart, Philadelphia, Pennsylvania, August 27.

Claim.—"What I claim as new, is, 1st, the inner doors or blowers made to slide in grooves within the front plates of the stove; serving, when closed, as a blower, and when not in use being withdrawn out of the way and out of sight, substantially in the manner and for the purposes as above described."

Re-Issues for August, 1850.

1. For an *Improved Concealed Trigger for Fire Arms;* Jacob Pecare and Josiah M. Smith, City of New York; patented December 4, 1849, re-issued August 13, 1850.

"The nature of our invention consists in so constructing a repeating or revolving pistol that the concealment of the trigger, hitherto unattained in revolvers, but particularly desirable in that kind of pistol, is effected, thus securing in an unusual degree efficiency of action, security from accidental discharge, and portability."

Claim.—"What we claim as of our invention, is the construction of a concealed trigger, capable of being disclosed and made ready to operate by simple pressure imparted by the hand to its rear end, as described herein."

2. For an *Improvement in Harvesters of Clover Heads and other Grain;* John Hinton, Pack's Ferry, Monroe county, Virginia; patented May 22, 1849, re-issued August 13, 1850.

"The nature of my invention and improvement consists in a novel combination and arrangement of an adjustive pendent bar, to which is secured a row of parallel metallic fingers and a knife or cutter, and right-angled mortised plates, and in the arrangement of spring conveyor bars, attached to the axletree of the propelling wheels and rotating with the same, by which the stems or stalks of clover, wheat, or other grain, are carried rearward against the knife between the parallel fingers,—severed and conveyed into the receiver while the machine is progressing."

Claim.—"What I claim as my improvement, is, 1st, the combination and arrangement of the transverse pendent finger bar, the mortised right-angled plates, the adjustive slide bars, and knife or cutter, with the revolving axletree of spring conveyor bars, arranged and operating in the manner described, by which the heads of clover, wheat, and other descriptions of grain, are severed from the stems or stalks, and delivered into a receiver.

"2d, I also claim the combination of the right-angled rods, fingers, and pendent bar, with the transverse timber, for adjusting the knife and fingers longitudinally and vertically in connexion with the spring conveyor bars, as described."

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3. For an *Improvement in Cooking Stoves;* Darius Buck, Albany, New York; patented May 20, 1839, re-issued August 27, 1850.

"The first part of my invention consists in making a heating chamber or flue in front of the oven of this class of stoves, which heating chamber or flue communicates at bottom with the direct and return flues under the oven, so that the passage of the products of combustion through the direct flue into the return flue will have the effect to produce a condition of heat in the said heating chamber, and thus heat the front of the oven.

"And the second part of my invention consists in extending the oven under the open hearth or apron, to enlarge it proportionally to the other parts of the stove, when this is combined with the direct and return flues at the back and bottom of the oven, and the heating chamber in front of the oven, by means of which the enlargement of the oven is heated equally, or nearly so, and thereby rendered more useful by reason of baking more equally."

Claim.—"What I claim, therefore, is, 1st, the heating chamber in front of the oven, in combination with the arrangement of direct and return flues at the bottom and back of the oven, substantially as described, for the purpose of imparting an equal, or nearly equal, heat to the oven, substantially as described.

"And 2d, I claim, in combination with the heating chamber in front, and the arrangement of direct and return flues at the bottom and back, substantially as described, the extension of the oven under the open hearth or apron of the stove, substantially as described, whereby the capacity of the oven is increased relatively to the other parts of the stove, and at the same time heated equally, or nearly so, as described."

Designs for August, 1850.

1. For a *Design for Cast Iron Brackets;* Walter Bryent, Boston, Massachusetts, August 13.

"My new design consists of the large Grecian scroll, terminating at each end in the volute, having a single leaf pendent from its centre, and an enriched double leaf pendent from its volute, said centre scroll being connected to the plates by the smaller Grecian scrolls, which are joined by the fluted ties, as shown in the drawings."

Claim.—"What I claim as my invention or production, is the combination of the central Grecian scroll, with its pendent leaves, with the several smaller Grecian scrolls and fluted ties, herein above enumerated and represented in the drawings; the whole forming a connexion between the vertical and horizontal plates of a cast iron bracket."

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2. For a *Design for Coal Stoves;* John F. Rathbone, Albany, New York, August 13.

Claim.—"What I claim as my production, is the combination and arrangement of ornamental figures and forms represented in the accompanying drawings, forming together an ornamental design for a coal cylinder stove."

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3. For a *Design for Stoves;* Billings P. Learned and Geo. H. Thatcher, assignees of Reuben J. Blanchard, Albany, New York, August 13.

Claim.—"What I claim as my invention, is the combination of leaves, vines, curves, and

other ornaments, as represented in the annexed drawings and herein described, as a design for cast iron stove plates, making part of a cast iron stove."

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4. For a *Design for Stoves;* Sherman S. Jewett and F. H. Root, Buffalo, New York, August 27.

Claim.—"What we claim as our invention, is the shape and configuration of the ornamental plates for stoves herein described."

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5. For a *Design for Stoves;* Robert Donavan, Pittsburg, Pennsylvania, August 20.

Claim.—"What I claim as my invention, is the ornamental design for stove plates, as described."

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6. For a *Design for a Parlor Stove;* Johnson, Cox, & Co., assignees of George W. Ring, Troy, New York, August 27.

Claim.—"What I claim as new, is the design and configuration of ornamental stove plates, substantially the same as described."

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7. For a *Design for a Stove;* Spencer Cole and George C. Mosher, assignees of William L. Sanderson, Troy, New York, August 27.

Claim.—"What I claim as new, is the design and configuration of ornamented stove plates, substantially the same as described."

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8. For a *Design for Stoves;* Charles W. Warnick, Philadelphia, Pennsylvania, August 27.

Claim.—"Your petitioner claims to be the original inventor or producer of the design and ornamental part of said stove, as described."

SEPTEMBER.

1. For *Improvements in Sub-Marine Vessels;* Lambert Alexandre, France, September 3.

"My invention consists, 1st, in securing within the working chamber or cabin of the vessel a pump, which is connected by pipes with an air-tight compartment from which it can draw air, and into which it can compress air at will, the connexion being such that, by moving proper cocks or valves, the pump becomes either a suction or a force pump, with respect to the air-tight compartment, or to the cabin.

"My second improvement consists in attaching to each side of the sub-marine vessel a ballast platform, which is hinged at its inner edge to the vessel, and is slung at its outer edge by chains from rings, which are hung upon the end of a pin at the top of the vessel; the arrangement of the various parts of this device being such that, when the pin is pulled inwards by the occupants of the vessel, the rings are let go, and the platforms, being no longer supported at their outer edges, turn down upon the hinges at their inner edges, and discharge instantaneously any load placed upon them."

Claim.—"What I claim as my invention, is the method of effecting a circulation of the air, and of maintaining an atmosphere in the cabin of the requisite bulk to prevent the encroachment of water during the descent of the vessel, and of preventing the waste of air by its expansion and escape from the cabin during the ascent of the vessel, by pumping it either out of, or into, the cabin or air reservoir as may be required, even when the density of the atmosphere in the compartment whence the air is drawn is less than that of the atmosphere in the compartment into which it is forced, as herein set forth.

"I also claim the device, consisting substantially of the drop-platforms, chains, and draw-pin, for the purpose of carrying ballast on the exterior of a sub-marine vessel, and of discharging it at will, as herein set forth."

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2. For an *Improved Method of Attaching Lines to Harpoons;* Charles F. Brown, Warren, Bristol county, Pennsylvania, September 3.

"The nature of my invention consists in an improvement in the mode of securing the line to the harpoon, by which the end of any line of suitable size and strength may be quickly secured without knots or splicing."

Claim.—"What I claim as new in my invention, is the manner of attaching and securing

the line to the harpoon, by means of the ring sliding on the shank, and the rounded end of the socket or butt, in the manner substantially as herein described."

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3. For *Improvements in Machines for Dressing Staves;* Lewis S. Chichester, Troy, New York, September 3.

Claim.—"What I claim as my invention in the before-described machine for shaving staves from rived bolts, is the employment of two concave knives for shaving the outer or convex surface of the staves, substantially as described, in combination with a single knife for shaving the inner or concave surface of the staves, when the said single knife is placed in a line midway between the other two: that is, opposite the space between the other two, substantially in the manner and for the purpose specified."

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4. For an *Improvement in Pressing Cotton and other substances into Bales;* S. A. Clemens, Granby, Hartford county, Connecticut, September 3.

"The first part of my invention consists in packing the substances above enumerated, and all others of a like character, in a series of successive layers or strata, by the action of a roller or rollers, or cylinders, or curved or beveled faces on the surface thereof, the pressure being in succession applied to one or more of such layers or strata, whereby the substance or substances to be pressed and packed is more evenly distributed, and therefore in a condition to be condensed into a more compact mass, and with less power, for the reason that the power is divided and applied by the surface of the roller or rollers, or cylinders, or their equivalents, to a small portion of the surface of each layer or layers, instead of the whole mass at once.

"The second part of my invention, which relates to the means for applying the first part of my invention, consists in combining with rollers or cylinders, or their equivalents, for laying and compressing in successive layers or strata a bed which shall recede from the surface of the rollers or cylinders as the layers or strata accumulate, and which either traverses back and forth under them, or over which they traverse from end to end, to distribute the layers or strata.

"The third part of my invention consists in combining with a press for packing and pressing substances in successive layers or strata, by means of rollers or cylinders, or their equivalents, a lapping machine for laying or forming the fibrous substance or substances to be packed, into a lap or laps, preparatory to the operation of laying and pressing.

"The fourth part of my invention consists in combining with each of the laying and compressing rollers, or their equivalents, a series of rollers, or their equivalents, for retaining the layers in their compressed state as the bed traverses under them.

"The fifth part of my invention consists in making the bed of the press without sides or ends, to admit of the traversing motion for laying, and the depressing motion for yielding as the substance is packed, and to give free access to the ends and sides for baleing, in combination with a carriage which is provided with the requisite means for giving the required movements, the said carriage being provided with end plates to adjust the ends of the layers or strata as they are laid and pressed.

"And the last part of my invention consists in combining with the end plates attached to the carriage for adjusting the ends of the layers, a permanent plate at the outer end of each series of rollers, and a little below them, so located that the upper surface of the end adjusting plates, as they, with the carriage, shall pass under and in contact with them, to push into place any portion of the layers which may have been carried by the rollers on to the upper surface of the end plates."

Claim.—"What I claim as my invention, is the method of packing and compressing substances into bales or packages in a series of successive layers or strata, by means of rolling pressure or its equivalent, substantially as herein specified.

"I also claim combining with the laying and compressing rollers or cylinders, or their equivalents, a bed which shall be gradually separated from the rollers or cylinders as the layers or strata accumulate, and which shall also traverse from end to end under the rollers or cylinders, or *vice versâ*, substantially as specified.

"I also claim, in combination with the cylinders for packing and pressing substances in successive layers, a lapping apparatus for forming such substance or substances into a lap or laps, to be delivered to the rollers or cylinders, or their equivalents, to be laid and pressed into the bed, substantially as described.

"I also claim, in combination with the laying and compressing cylinders, or their equivalents, the series of rollers, or their equivalents, for retaining the layers or strata as they are successively compressed, substantially as specified.

"I also claim the bed made without sides or ends, substantially as and for the purpose spe-

cified, in combination with the carriage provided with adjusting plates at the ends, for the purpose and in the manner substantially as described.

"And finally I claim, in combination with the adjusting plates at the ends of the carriage, the stationary plates at the ends of the frame, under which the adjusting plates pass, to remove any substance that may have accumulated on them, substantially as described."

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5. For *Improvements in Repeating Fire Arms;* Samuel Colt, Hartford, Connecticut, September 3.

"My invention consists in making the central bore of the rotating chambered breech to extend from the rear part thereof to within a short distance of the front end, which is thus closed to prevent the entrance of smoke, when this is combined with the attachment of the barrel to the breech-piece or lock-plate, or both, independently of any connexion with the central pin or arbor on which the chambered breech rotates."

Claim.—"What I claim as my invention, is making the central bore of the many-chambered rotating breech, which fits and turns on a central pin or arbor, to extend from the rear part thereof to within some distance from the front end, and thus leave the front end closed, substantially as described, to prevent the access of smoke, when this is combined with the connecting of the barrel with the shield-piece and lock-plate, substantially as described."

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6. For an *Improvement in Hand Spinners;* David Current, Crittenden, Kenton county, Kentucky, September 3.

"The nature of my invention and improvement consists in arranging on rails secured to the upper surface of a suitable platform, a traversing carriage on which a spindle is suspended, and causing said carriage to be moved back and forth by means of bands passing over wheels and pulleys, without requiring the operator to move from one position; and also in providing the apparatus with a clamp lever for giving a backward motion to the spindle in case the thread becomes too taut, to prevent breakage."

Claim.—"What I claim as my invention, is the combination of the clamp lever with the cords and drum, for the purpose and in the manner substantially as described."

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7. For a *Machine for Beveling the Surfaces of Washers, &c.;* William Field, Providence, Rhode Island, September 3.

"The principle or character of the first part of my invention consists in drawing out and giving the bevel form to metal clinch rings, &c., by the action of the surfaces of traveling rollers turning on bearings arranged about a common centre of rotation, that the surface of the said rollers may in succession be made to pass over the surface of a piece of metal, and thus draw out or give it the form required, as a substitute for the action of a hammer, when this is combined with a spindle or mandril, to which are fitted the holes in the clinch rings or washers to be operated on; the said spindle being provided with the necessary means for turning it, that the clinch ring or other article, when put thereon, may be turned to present in succession every part of the circle to the action of the rollers.

"The second part of my invention consists in combining with the spindle, for presenting the ring to the action of the rollers, a gripe for griping and holding the ring or washer into the spindle whilst being acted upon."

Claim.—"What I claim as my invention, is the method substantially as herein described, of drawing out and giving a bevel form to metal clinch rings, washers, &c., by the action thereon of the surfaces of a series of traveling rollers, turning on bearings arranged about a common centre of rotation, and combined with a spindle or mandril adapted to the reception of the clinch rings or washers to be formed, and provided with the means, substantially as herein described, for turning it, to present in succession every part of the periphery to the action of the rollers, substantially as described.

"I also claim, in combination with the spindle or mandril for presenting the clinch rings or washers to the action of the traveling rollers, a gripe, substantially as described, for griping and holding the said rings or washers on to the spindle or mandril, whilst passing under the action of the traveling rollers as described."

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8. For an *Improvement in Draining Sugars;* Conrad William Finzel, Bristol, England, September 3; anté dated October 12, 1849.

"My invention consists in a mode of applying steam or liquids to machines used for separating fluids from sugar by means of centrifugal force, for the purpose of clearing, and keep-

ing clear, the meshes or apertures in the periphery of the revolving cylinders of such machines."

Claim.—"I claim as of my invention, the mode of applying steam or liquids to machines used for separating syrups or fluids from sugar by means of centrifugal force, for the purpose of clearing, and keeping clear, the meshes or apertures in the periphery of the revolving cylinders of such machines, in manner herein described."

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9. For an *Improvement in Clamps for Holding Paper and Drawing;* Eliakim B. Forbush, Buffalo, New York, September 3.

"The nature of my invention consists in making an apparatus to attach to a thin board, desk, table, or other place, for the purpose of holding paper or other material firm and smooth in the position in which it is placed for writing, drawing, coloring, or other purpose."

Claim.—"What I claim as my invention, is the clamping slides made to slide freely on the parallel rods, operated by the lever and the springs, substantially in the manner and for the purpose as herein set forth."

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10. For an *Improvement in Fastenings for Hay Rakes;* Orange W. Hogle, Somerset, Niagara county, New York, September 3.

"My improvements relate particularly to the manner of constructing the wooden cyma-reversa teeth of the rake, and the manner of holding them during the operation of raking, and the manner of revolving them whilst discharging the hay into a window; the formation and arrangement of said teeth and other parts of the machine being such as to render the rake the lightest, cheapest, and most symmetrical rake of all the revolving horse hay rakes now in use."

Claim.—"What I claim is, 1st, the manner of holding the teeth firmly in their required positions against the sliding bar during the operation of the machine, by means of the aforesaid combination of the ratchet wheel, pawl, sliding bar and stem, helical spring *n*, fixed bar, and slide attached thereto, with the parallel guiding arms and revolving finger shaft, arranged and operating in the manner and for the purpose above set forth.

"2d, I likewise claim the combination of the slide, helical spring *g*, strap, and roller, with the parallel arms and fixed bar, for disengaging the sliding stop bar from the rake teeth without moving the hand from its usual position on the hand roller, to allow the teeth to revolve to deposit the hay in windrows, as set forth."

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11. For an *Improvement in Stoves;* Sherman S. Jewett and Francis H. Root, Buffalo, New York, Septemper 3.

"Our improvement consists in constructing the front or end plates of stoves or grates with recesses in their jambs, closed in front by doors; these recesses are of sufficient capacity to receive the doors of the fire place, which, when opened, are turned back into them, and are concealed from view by shutting the doors of the recesses."

Claim.—"What we claim as our invention, are the jambs of stove or grate fronts or ends constructed with recesses closed by doors, within which the doors of the fire place are folded up and concealed from view; the fire place doors being constructed and arranged to turn back into the recesses, substantially as described."

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12. For an *Improvement in Car Couplings;* David S. Neal, Lynn, Essex county, Massachusetts, September 3.

Claim.—"What I claim as my invention, is the bearing roller or rollers placed within the body of the coupling, and the bearing roller located in one end of the connecting link, for the purpose of enabling the connecting bolt to be easily detached from the link when the cars are in motion; when this arrangement of the said rollers and connecting bolt is combined with the loop, the catch-head, and cord, for uncoupling, in such a manner that the loop will be disengaged when force is applied to withdraw the bolt, but will prevent the connecting bolt from being accidentally thrown out of place when the cars are in motion."

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13. For an *Improvement in Planing Machines;* J. F. Ostrander, City of New York, September 3.

"The nature of my invention consists in the peculiar construction of the cutter or planer, and its combination with a reciprocating frame, and compressor spring for holding the face

of the plank or other material from splitting or lifting while under the edge of the cutter, when in motion; and the combining and adapting the same with feed rollers, tonguers, and groovers, and driving power, for the purpose of planing, tonguing, and grooving plank and other substances."

Claim.—"What I claim is, 1st, the use and employment of the cutter, made and fashioned in form and manner described, or any analogous form and manner, whereby the peculiar cutting, beveled, scolloped edge is attained, for planing or dressing plank or other material, substantially as set forth.

"2d, I also claim the use and employment of the cutter, in combination with the compression spring feed rollers and straight edge, or any one or more of them, in form and manner and for the purposes substantially as set forth."

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14. For *Improvements in Sewing Machines;* Philip May, London, England, assignee of Barthelemy Thimonnier, Sr., Amplepius, Department du Rhone, France, September 3; anté dated February 9, 1849.

"This machine mainly consists of so constructing the parts and combining them, that the fabric or fabrics are to be supported on a surface through which (and opposite to the hook used to produce and draw through the stitches) there is a hole, so that the hook employed, having passed through one or more thickness or thicknesses of fabric, it will pass through such hole, and when beyond the plate or surface, a thread of silk, cotton, or other material, will be caused to be laid partly round the stem of the hook, in such manner that the hook, in passing through the fabric or fabrics, will carry with it a loop of such thread, there being a tube or instrument retaining down the fabric or fabrics till the hook has passed back. The fabric or fabrics are then to be moved a distance equal to the length of the stitch, the hook is again caused to pass through the fabrics, and the holding down instrument holds the fabric, and the thread is again wrapped partly round the stem of the hook, which, in again going back through the fabric or fabrics, draws the new loop through the one or more thicknesses of fabric, and also through the previous loop, the work produced being what is called tambour stitch; and it is combining the use of a hook with a perforated surface, against or on which the fabric is held by a tube, (or other holder acting in like manner,) acting with a thread carrier which partly rotates, which constitutes the peculiar character of this invention over those machines and apparatus before made, where tambour hooks have been used.

Claim.—"What I claim is the hook, the surface, the tube or holder, and thread carrier, working substantially as above described."

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15. For *Improvements in the Direct Action Steam Hammer;* Samuel V. Merrick, assignee of John H. Towne, Philadelphia, Pennsylvania, September 3.

"My invention is an improvement on the steam hammer of James Nasmyth of Great Britain. In the steam hammer invented by James Nasmyth, as aforesaid, the hammer is operated by, and is attached to, the piston rod of the steam piston, a spring being interposed between the said hammer and piston rod, to prevent as much as possible the upsetting of the said piston rod by the percussive action of the hammer.

"The object of my invention is to avoid the difficulty and inconvenience of interposing such spring, or the very injurious effects of the percussion, when the hammer is attached to the piston rod, without the interposition of a spring. To this end, the nature of my invention consists in combining the hammer with the movable cylinder, the steam being admitted and discharged to and from the movable sliding steam cylinder."

Claim.—"What I claim as my invention, is attaching the hammer to the sliding steam cylinder, substantially as herein described, the steam being admitted and discharged to and from the sliding steam cylinder, substantially as herein described."

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16. For *Improvements in the Manufacture of Lead Pipe;* William P. Tatham, Philadelphia, Pennsylvania, September 3.

Claim.—"What I claim as my invention, is the method substantially as described, of setting or cooling the inside of the mass of metal within and throughout the length of the cylinder, and before or preparatory to pressing out the pipe, by passing a cooling fluid into or through a long core or core-holder extending through the length of the cylinder, as described, the said method having the effect at the same time to keep the said core or core-holder cool and stiff, as described."

17. For an *Improvement in Apparatus for Breaking Horses;* Seymour Tomlinson, Washington Hollow, Dutchess county, New York, September 3.

"The nature of my invention consists in the method of breaking and controling a horse, by harnessing him to a pair of shafts connected together at their front ends by means of a bow which passes around in front of the horse's breast, the harness consisting of two straps, one passing from the bow over the horse's crest, and the other from the shafts under the horse's breast, and back of the front legs."

Claim.—"What I claim as my invention, is the method substantially as herein described, of breaking horses by means of the shafts which are connected together by a bow passing around in front of the horse's breast, substantially as herein described, in combination with the two straps, one passing over the crest and the other under the breast, by which the horse is harnessed to the said shafts, substantially as described."

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18. For an *Improvement in Surgeons' Splints;* Benj. Welch, Lakeville, Litchfield county, Connecticut, September 3.

"The nature of my invention consists in the formation of the aforesaid splints by the combination of very thin boards, by means of some elastic adhesive substance interposed between them."

Claim.—"What I claim as my invention, is my improved surgeons' splint, composed of thin strata of wood combined with some elastic adhesive substance interposed between them, substantially as herein set forth."

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19. For an *Improvement in Ladies' Stays;* Louisia Balis, Oriskang, Oneida county, New York, September 10.

"My invention consists in a proper distribution of the support, likewise protection given to the body by a new arrangement of the position, length, and shape of the lower gores; also a new construction of the shoulder strap, by means of which the chest can be expanded in a proper and effectual manner."

Claim.—"What I claim as my invention, is the peculiar arrangement (in the body of the stay) of the whale-bones, in combination with the gores of the peculiar form, and in the particular position, represented, whereby the usual irritating effects of ladies garments upon the muscles, &c., about the loins are avoided, at the same time that effectual support is given to the whole waist, by means of the peculiar position and shape of the gores, and then the easy curves given to the whale-bones, as set forth."

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20. For an *Improved Mode of Representing Musical Scales;* W. B. Billings, Eastport, Washington county, Maine, September 10.

"The nature of my invention consists of a frame of wood carrying a board representing the ground-work of the scales; at each side of the board are placed movable bars of metal or wood, each provided with corresponding series of holes which receive the ends of the cross-bars or wires, the holes in the side bars being so arranged that, by means of the required number of cross-bars, and a movable centre piece, all the major or diatonic scales and their relative minor scales, the chromatic scale, and the enharmonic scale, may be represented, a letter being attached to each bar to indicate what sound it represents. Attached to one side of the frame is a board having staves marked upon it, to assist in explaining the necessary exercises."

Claim.—"I claim the manner herein described, of representing each and all of the scales used in music, by the combination of the board, the side bars *c c*, the centre piece, and the bars *d d d*, and *d' d' d'*, having letters attached to them to indicate the name of the notes they represent, or any other combination of parts substantially the same."

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21. For *Improvements in Revolving Chambered Fire Arms;* Samuel Colt, Hartford, Connecticut, September 10.

The first part of my invention relates to the method of insuring the true and accurate position of the breech at the end of each shift of the chambers, preparatory to the discharge, and consists in combining with the holes which receive the end of the locking bolt, elongated grooves of less depth, and extending from one hole towards the next throughout the series, so that the end of the locking bolt, which enters by a spring and is withdrawn by the lock, shall enter the elongated grooves, and be within the surface of the rotating breech, before the chamber is brought to the line of the barrel, and thus be in a position to insure the stoppage of the breech when it reaches the line of the barrel, and then enter the locking

hole before it can rebound or turn back. By this means the arm can be operated with the utmost rapidity without any danger of having the barrel out of its true line at the time of the discharge.

"And the second part of my invention, which relates to the manner of locking the breech when the arm is at rest, to prevent accidental discharges, consists in locking or holding the rotating breech midway, or nearly so, between any two of the chambers, by a hole in the face of the cock or hammer fitting on to a projection of the rotating breech, or *vice versâ*. By this means, if the cock or hammer be struck when the arm is at rest, no explosion can take place, as the hammer in that position is not in contact with either of the nipples, which with the breech so situated, are effectually protected by the shield plate."

Claim.—"What I claim as my invention, and as an improvement for fire arms having a rotating breech with a series of parallel chambers, is, in combination with the locking holes of rotating chambered breech fire arms, substantially such as herein specified, making grooves leading to each locking hole, substantially in the manner and for the purpose specified, when this is combined with a bolt independent of the mechanism which rotates the breech, and which bolt enters to lock by a spring, and is withdrawn by its connexion with the lock, substantially as described.

"And I also claim holding the rotating breech midway, or nearly so, between any two of the chambers, to prevent accidental discharges, by means of a recess or hole in the hammer or cock, fitting on to a projection of the rotating breech between any two of the chambers, or *vice versâ*; substantially as herein specified."

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22. For an *Improvement in Paint Mills;* W. W. Draper, Greenfield, Franklin county, Massachusetts, September 10.

"The nature of my invention consists in the shape of the grinding face given to the muller, when it is combined with the smooth face of the bed, viz., the face of the muller having broad depressions formed in it, extending from near its centre to within a short distance of its periphery, and a corresponding number of narrow discharging grooves that extend to the periphery of the same, one of which grooves is located immediately in front of each of the depressions; the object of the depressions in the muller being to keep a large body of paint in contact with the face of the bed, and gradually distribute it between the grinding faces of the bed and muller, while they at the same time prevent the escape of the paint therefrom before it is thoroughly levigated; the said grooves serving to collect the levigated paint after is passage over the smooth surface of the muller face, between the rear edge of the depressions and the grooves, and discharge the same at the periphery of the muller."

Claim.—"What I claim as my invention, is the broad depressions in the face of the muller, when combined with the discharging grooves in the same, and with the plane surface of the bed, substantially in the manner and for the purpose as herein set forth."

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23. For an *Improvement in Picking Cotton from the Bolls in the Field;* Samuel S. Rembert and Jedediah Prescott, Memphis, Tennessee, September 10.

Claim.—"What we claim as our invention, is, 1st, the combination of the whipping cylinder with the picking disks and the strippers B B; and also the combination of the whipping cylinder with the picking cylinders and the strippers D D, substantially in the manner and for the purpose set forth.

"2d, We claim the combination of the picking disks and the strippers B B, with the gathering planes and the cotton receptacle, substantially in the manner and for the purpose set forth.

"3d, We claim the combination of the picking cylinders and the strippers D D, with the gathering planes and the cotton receptacles, substantially in the manner and for the purpose set forth."

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24. For an *Improvement in Smiths' Strikers;* Melchi Scott, Claysville, Washington county, Pennsylvania, September 10.

Claim.—"What I claim as my invention, is attaching the raising and rebound springs, and the hammer, to the same adjustable frame, substantially as described, when this is combined with the adjustable attachment between the hammer and the treadle, whereby the hammer can readily be adjusted to strike a flat blow on iron of different thickness."

25. For an *Improvement in Camp Bedsteads;* William C. Shaw, Philadelphia, Pennsylvania, and James Stalcup, Wilmington, Delaware, September 10.

Claim.—"What we claim as new, is, 1st, so arranging the parts of a camp chest that, when it is unfolded in a direction parallel with its length, it will constitute a bedstead which may be of the width of the inside of the chest, and when unfolded in a direction at right angles with its length, it will constitute a bedstead which may be of the width of the inside of the length of the chest.

"And 2d, The arrangement by which a part of the front of the chest can be used as a table-leaf, and the slides as seats at the table, substantially in the manner and for the purpose set forth."

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26. For *Improved Exhaust Passages for Steam Cylinders;* George Shield, Cincinnati, Ohio, September 10.

Claim.—"What I claim as new is the twofold outlet or steam passage from the cylinder into the exhaust valve chamber, which admits the steam above and below, and discharges it between the disks of the exhaust balance valve, and thus facilitates the insertion, withdrawal, and adaptation to the exhaust side in the line of its stem, or spindle of a balance valve, whose disks are cast in one piece, and are held down to their seats by the stress of steam."

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27. For an *Improvement in Mortising Machines;* Smith Spencer, Angelica, Alleghany county, New York, September 10.

Claim.—"What I claim as new, is, in combination with a device for giving the chisel a reciprocating motion, the device for giving it at the same time an oscillating motion, substantially as set forth."

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28. For an *Improvement in Machines for Scribing Lumber;* John Shellenberger, Indianopolis, Morrison county, Indiana, September 10.

"The nature of my invention consists in a frame provided with suitable rests and stops, upon and between which I place the stuff in which I desire to mark out and scribe the mortises and tenons. Two sliding carriages provided with cutters or gauges, one moving vertically and the other horizontally, are operated by suitable mechanism for scribing the sides and edges of the stuff. The cutters being set in any required position will scribe any number of pieces. A cutter or gauge is also placed in one of the sliding carriages, which, on the carriage being fixed, may be operated in a diagonal direction, for the purpose of scribing bevel mortises."

Claim.—"I claim the manner of operating the horizontal sliding carriage carrying the cutter blocks F F, and the cutters *f f*, and the vertical sliding carriage carrying the cutter blocks F^2 F^2, and the cutters or scribers f^2 f^2, in such manner that they perform the duties in concert without interferring with each other, by means of the levers G G, the rods *h h*, the levers *a a*, the straps *e e*, the levers *i j i j*, and weights *k k*, in combination with the pulleys, the straps J J, the rods *l l*, the levers K K^2, and the weights L L^1; the levers G G, and the pulleys, being hung up on the same shaft, and operated by the same treadle, substantially in the manner and for the purposes described."

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29. For an *Improvement in Clover Hullers;* Robert Stadden, Milton, Northumberland county, Pennsylvania, September 10.

Claim.—"What I claim as new, is the continuous wave-form of the rubbers of the concave; and I further claim the continuous wave-form of the rubbers if it should be applied to the cylinder instead of the concave."

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30. For an *Improvement in Plough Clevises;* John B. Stoner, Southampton, Cumberland county, Pennsylvania, September 10.

Claim.—"What I claim as new, is forming a plough clevis by means of two arcs of metal of corresponding outward curvatures, having the point of attachment of the draft link to the martingale for their common centre of curvature, in the manner and for the purpose set forth."

"2d, I also claim, in combination with a fixed horizontal arc, having a slot between bearing edges, the vertical arc having notches on its inner curve adapted to the bearing edges of the fixed arc, whereby the direction of draft may be varied horizontally or vertically, as required."

31. For an *Improvement in Friction Rollers;* Joseph M. Totten, Peoria, Peoria county, Illinois, September 10.

Claim.—"What I claim as my invention, is the friction rollers, each composed of a series of separate sections, held together by nuts or otherwise on a common spindle, in such manner that the spindle and roller sections usually turn together, but when any obstruction intervenes to stop the movement of any one section, and thus cause it to grind and flatten, the adjacent sections, with the spindle, continue to roll on, and, by rubbing against the obstructed one, tend to move it past the obstruction, thereby preventing continued excessive wear on any one portion of its periphery; hence the irregular wear of any one of the sections will not affect the general roundness of the whole to such a degree as will materially impair the efficiency of this device as an anti-friction roller."

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32. For an *Improvement in Plough Cleaners;* David Warren, Gettysburgh, Adams county, Pennsylvania, September 10.

"The nature of my improvement consists in combining with any common plough a vibrating finger clearer, arranged in such a manner in relation to the throat or sheath of the plough, that by the simple use of the hand of the ploughman to elevate and depress a lever, a series of fingers will be made to vibrate back and forth adjacent to the sheath, and clear away straw, stubble, or other obstructions which may accumulate around the sheath of the plough while it is ploughing, thus dispensing with the necessity of stopping the team to relieve the plough."

Claim.—"What I claim as my invention, is the combination of the vibrating finger clearer with the beam and sheath of the plough; said finger clearer being arranged in such a manner in relation to the sheath or throat of the plough, that, by the use of the hand of the ploughman to elevate and depress a lever, a series of curved or straight fingers will be made to vibrate back and forth adjacent to the sheath, and clear away straw, stubble, and other obstructions therefrom, as described."

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33. For an *Improvement in Tailors' Measures;* William W. Allen, Bordentown, Burlington county, New Jersey, September 10.

Claim.—"What I claim as my invention, is the use of the slides for laying off the division of the several measures for a coat, in combination with the fashion slides, for the purpose and in the manner set forth."

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34. For an *Improvement in the Seeding Roller of a Seed Planter;* Aaron Palmer, Brockport, Monroe county, New York, September 10.

Claim.—"What I claim as my invention, is the constructing a seeding wheel for a planting machine by the combination of the two parts of the form described, in such a manner that, by turning one of the said parts within or upon the other in one direction, the planting receptacles will be reduced in depth and size, and, by turning the said part of the seeding wheel in an opposite direction, the planting receptacles will be enlarged in depth and size, substantially as herein set forth."

MECHANICS, PHYSICS, AND CHEMISTRY.

Report upon the Telegraphic Apparatus of M. Siemens, *of Berlin, presented to the Academy of Sciences, Paris.**

Continued from page 212.

M. Siemens has effected a most important advantage in the arrangement of alphabetic telegraphs, by means of which the party receiving the message can, at the same time, communicate with the other party without having recourse to a second wire, or in any way disturbing the arrangement of the apparatus or interrupting the delivery of the message. For the purpose of enabling a party, while receiving a message, to communi-

* From the London Journal of Arts, Sciences, and Manufactures, Vol. xxxvi., 1850.

cate with the party sending it, in order to correct an error or have an imperfectly understood signal repeated, &c., M. Siemens entirely dispenses with the interrupter, and arranges his dial apparatus in such manner that it shall act precisely in the same manner, whether sending or receiving a message.

We will endeavor to give an intelligible description of this ingenious apparatus, which acts with great speed and perfect regularity. The armature of the electro-magnet is provided with a lever, about an inch in length, which produces two very different actions. The effect of the first is, at every double vibration, (backwards and forwards,) to drive forward the wheel, which is mounted upon the shaft of the needle or indicator, the distance of one tooth, and, consequently, carries the needle forward a letter. By the second action it breaks the circuit and stops the current from which it has itself received its motion; but not until it is itself stopped in its forward motion, *i. e.*, when the armature, attracted by the electro-magnet, has approached as near the poles as possible: the circuit being then broken, the armature ceases to be attracted, and being immediately drawn back by its spring, the lever returns to its former position. By this means the circuit is again completed, and the current re-established; and the lever is immediately carried forward again by the armature, to return again as before. These isochronal vibrations would proceed for an indefinite period, as long as the battery furnished a current of equal intensity; but they would become slower as its power diminished, and finally cease when the action of the current became too weak to endue the temporary magnet with power sufficient to overcome the inertia of the armature, and the tension of the spring which holds it back from the poles.*

Two similar apparatus of this kind introduced into the circuit, one at Berlin and the other at Paris, would work with perfect synchronism, (excepting the speed of the electricity, which need not be taken into account;) and if they were in accord at the commencement, *i. e.*, if the needles corresponded with the same sign, they would make thousands of revolutions, and would work for days and even years in concert; that is, they would always at the same instant be opposite similar signs: this apparatus derives its motion entirely from the battery. The indicating needle would, however, have a regular movement, like that of the second-hand of a watch, but it would be more rapid, as it might be made to move an entire revolution in a second, taking only the thirtieth part of a second to travel from one sign to another,—supposing the lever of the armature to make thirty double vibrations per second. M. Siemens has, however, only tried his apparatus at one-half this speed, viz., a revolution every two seconds, or a double vibration of the lever of the armature every fifteenth part of a second. This does not imply that his needle will indicate fifteen signs per second, or nine hundred per minute, for the eye could scarcely follow the

* In 1843, M. de la Rive augmented the chemical action of a simple element by introducing into the circuit an electro-magnet, the armature of which, by its slow vibrations, effected successive ruptures. In 1846, M. Froment, applying the same principle under another form, caused the armature of an electro-magnet to vibrate with sufficient velocity to produce very sharp sounds. (*Comptes Rendus, Vol.* XXIV., *p.* 428.) At the same period M. Froment employed these vibrations as a motive power, after having added to his apparatus a mechanical arrangement capable of being regulated at pleasure, and which broke the circuit at any required period.

needle; besides, with this regular and uniform jerking motion, it shews all the signs equally, and produces the same effect as if it indicated none, as the observer cannot distinguish anything or follow its movements. The same effect is produced as if a person were to recite the alphabet several times over in a perfectly monotonous tone, without laying emphasis upon any particular letter;—it would be utterly impossible to distinguish what he had been saying.

Something still remained, therefore, to be added to the above apparatus; the needle must be stopped in its course, not for a long time, but during half a second, or perhaps only a third or a quarter of a second, according to the quickness of the movements of the parties sending and receiving the message: by this means the needle would point out the letter to which it is required to direct attention. To obtain this result, M. Siemens has placed around his dial as many stops as there are signs, and upon each stop the sign to which it belongs is legibly marked. On pressing the finger upon any one of these stops, a small vertical rod of one or two-thirtieths of an inch in diameter is depressed, which rod acts as a stop to a horizontal lever parallel to the needle and mounted on its axis. This has exactly the same effect as if the needle itself were stopped, but the mechanism is hidden under the dial, in order not to distract the attention of the operator. It is not sufficient for the needle to be stopped exactly opposite the sign it is intended to indicate; it is important that the motive lever affixed to the armature, the vibration of which is arrested by the same obstacle, should then be midway in its return motion, which is caused by the action of the spring.

The person sending a message has, therefore, only one operation to perform, viz., to lay his finger successively upon the stops corresponding to the signs he is desirous of transmitting, and when the needle comes round to the sign, (the stop of which is depressed,) it will stop. The needle at the other station, although its motion is synchronical, will not stop at precisely the same instant, as the lever which moves it, being also drawn back by its spring, is obliged to return,—as it does not, like the other one, meet with any bodily obstacle to its progress; it therefore completes its return motion, and assumes the position required for completing the circuit and re-establishing the current. This, however, cannot take place immediately, as the needle at the other station is retained in a position in which it breaks the circuit. Thus the operator who is sending the message, by placing his finger upon a stop for a fraction of a second, gives a sudden check to the movement of the needle at the other station; but it must be remarked that the two needles cannot stop at the same instant, the second is not arrested until the expiration of about a quarter the duration of a complete duration. This circumstance is important, from the influence it exerts upon the number of signs which may be transmitted in a given time.

Upon the person who sends the message raising his finger from the first stop, in order to act upon another, the following actions will take place: The lever of his apparatus, obeying the action of its spring, is free to complete its return motion, which it does. The circuit being thus completed the current will be re-established; the armatures of the two stations are simultaneously attracted, and the needles resume their progress until the

next stop is depressed; this will act on the needle of the other station, and the action will be repeated as before. The person receiving the message has only attentively to follow the movements of his needle, and write down or dictate the signs which its indicates; but if he is in doubt or difficulty, he lays his finger upon a stop, and thereby arrests the movement of the needle at the other station; he will thus be enabled to communicate with the other party and clear up the difficulty, after which the transmission of the message may be resumed. It will be understood that by this apparatus the communication will assume the nature of a verbal conversation, in which each party can put in his word.

The apparatus of which an idea is given above does not require any auxiliary; but in that case reliance must be placed upon the correctness of the party receiving the message. To provide, however, against the effects of negligence, M. Siemens has arranged a magnetic printing apparatus, by means of which the message may be as well printed as by a press. When this is used the person receiving the message has nothing to do while his apparatus is at work, but at the end of the operation he will find a strip of paper upon which the letters of the message are accurately printed, with a larger space between the words than the letters. It might even be correctly punctuated to render the text intelligible, but for ordinary communications this will be quite unnecessary.

The printing apparatus, which is at once ingenious and effective, is constructed in the following manner:—A vertical shaft precisely similar to the shaft carrying the needle, and receiving rotary motion by means of precisely similar mechanism, carries at its upper part thirty horizontal radiating arms, set in the same plane at equal distances apart, and on each of these arms, near the end furthest from their axis, at their upper part, is a letter in relief. These arms are flexible, and as they act in the same manner as springs, it will be sufficient to drive them upwards against the fillet of paper a little above them, and make them press against it with a suitable amount of force. This fillet of paper passes round about half the circumference of a printing roller provided with printing ink, which is only communicated to the paper at those parts where the arms carrying the types are made to strike, at which parts the letters will be clearly printed.

There are, however, peculiar arrangements of mechanism for the purpose of fulfilling the two following conditions, viz., 1st, To enable the printing roller (which must be stationary at the moment of printing) to turn and carry the paper round a suitable distance, for the purpose of producing a blank space as soon as it has received a letter, and a larger space when a word is completed. 2d, To enable the hammer which strikes the letter underneath to do so at the precise moment when this latter stops to receive the blow.

It has already been said that the arms which carry the letters in relief receive motion in the same manner as the needle, *i. e.*, they themselves form a kind of revolving dial; so that all the letters come in succession under the hammer, which is a fixture. The party also who sends the message can, by pressing upon a stop, arrest for an instant a type at the other station in the same manner as he stops the dial needle at any particular letter.

It now remains to explain how the hammer is caused to act during that

instant. This is effected by means of a powerful electro-magnet, worked by a separate battery, the current of which is, of course, distinct from that of the telegraphic circuit. Each time that the motive lever of the telegraph performs a vibration and passes a type, it establishes a communication between the poles of the auxiliary battery, or, in other words, it completes the circuit of the printing electro-magnet;—this latter, however, does not act immediately, as it is constructed so as to be affected more slowly by its current; but, when the motive lever stops for an instant under the action of its spring,—that is to say, at the limit of its return, in order to repeat the sign which the other station had transmitted,—the printing electro-magnet receives from the current which passes through it sufficient power to actuate the heavy armature. By this movement it produces the following effects:—1st. By means of a long lever attached to it, the hammer is caused to strike the type or letter. 2d. By a second lever, which acts a little later on a ratchet-wheel, the printing roller, with its fillet of paper, is turned the extent of one ratchet-tooth: this roller has also a longitudinal movement, in order to enable the whole surface of the paper to be printed upon. 3d, By means of a third lever, the circuit of the auxiliary battery is broken; and thus the power which actuated it is destroyed, and the lever is instantaneously drawn back by its spring. 4th. By means of a fourth lever, which only acts at the completion of each word, the armature of the printing electro-magnet strikes a bell, and thereby signals to the parties at the opposite stations whether their apparatus agree. This action is effected by an ingenious arrangement:—each word is terminated by a blank stop; and the arm corresponding to that stop has no letter upon it; the hammer, therefore, on striking, not meeting with any resistance from a letter in relief, make a rather longer stroke, and allows the armature, to which it is attached, also to proceed further. By this means, the bell is struck by the fourth lever at the end of each word only,—it being silent while the letters are being printed.

M. Siemens has also adapted an apparatus which he calls a *transmitter*, which is only intended to transmit messages between two very distant stations. This apparatus is on the same principle as the above; but, besides this, it presents an interesting application of the theory of derived currents. The current which circulates between the stations (properly called the telegraphic current) may be very weak, as scarcely any effort is required of it;—its only function being to open and close the circuit at the proper time. The currents from the batteries of the respective stations, then passing almost exclusively into the signal apparatus, will possess sufficient power to work them; and, when their office has ceased, the weak telegraphic current will act in its turn to prepare the apparatus for the next signal.

The Commission have examined M. Siemens' apparatus with great interest, and remarked throughout an evidence of a perfect intelligence of the theory, as M. Siemens appears to have taken into account all the complicated phenomena which are manifested in the conductors and electro-magnets, especially when the actions are of short duration.

M. Siemens' system, if worked with care and attention, appears to possess incontestible superiority over all other apparatus of the like nature,—that is to say, the ordinary arrangements of alphabetic apparatus; as the

latter do not work with the same degree of precision and accuracy. With regard to speed, the Commission are led to believe that M. Siemens' apparatus surpasses all other alphabetic apparatus; their opinion is also that M. Siemens' improvements in the construction of electro-magnets will prove advantageous,—more especially if care be taken to associate two magnets of equal power.

For the Journal of the Franklin Institute.

Paddle Wheels for Marine Steamers.

In a paper published in the last two numbers of this Journal, upon the comparative merits of the "Perpendicular" and "Radiating" paddle wheel for marine steamers, Mr. Isherwood, of the U. S. Navy, has undertaken to prove the superiority of the former kind, known as "Morgan's Vertical Wheel," adducing in support of his position the case of two English war steamers, fitted respectively with either.

We confess that, notwithstanding the apparent correspondence existing between his theory, data, and calculations, we are not fully satisfied of the propriety of adjudging a question so important to the economy of a steam marine upon grounds which a little examination will show to be entirely unsubstantial.

So much has already been written upon the subject, theoretically considered, that it is evident the author must, in support of his opinions, depend mainly on the character of results attained in practice, of which he gives an example; it is principally with his data, therefore, that we have to do at present.

In the example before us, the steamers are of 600 and 900 tons, and are respectively named the "Black Eagle" and "Trident," the first fitted with Morgan's, the latter with the ordinary wheel. The "Black Eagle" has two engines, with cylinders 62 inches by $4\frac{1}{2}$ feet stroke; the "Trident," two, with cylinders $70\frac{3}{4}$ inches by 5 feet stroke; wheels about the same size (effective diameter) in both, but the area of a single paddle in the *smaller* vessel is 1·27 times that of the *larger*,—a fact which will partially account for the very unusual circumstance of greater slip being found with the ordinary than with Morgan's wheel, at light immersions. The mean average pressure of steam is said to be the same, but is evidently not given by an indicator diagram, or if it *is*, that authority should have been furnished, because every engineer knows that to be the only reliable source for the datum in question; and the most important circumstance of all, viz., the consumption of fuel, is entirely neglected. Under these circumstances, the vessels are respectively found to attain speeds of 13·14 and 11·92 statute miles per hour; and Mr. I. thence infers, after entering into a *lengthy* calculation of powers and effects, that the Morgan wheel is "better in the proportion of 1·000 to 0·9055" than the radial wheel.

It will be observed that, at the times of the experiment, the two wheels are at very different dip; that while the *Morgan* is immersed about 0·25 of its diameter, the other has a dip of only 0·10 of its diameter, which is less than one-half of the usual mean immersion.

Now it has been shown, by experiments made some years ago at Mauds-

lay & Fields' Works, London, (for an account of which see the paper of Mr. P. W. Barlow, *Tredgold's 1st Appendix*, pp. 54 to 56,) that, while a Morgan wheel, immersed to one-fourth (·254) its diameter, would overcome a resistance of 8175, (found by multiplying the square of its velocity by the weight employed in moving the wheel,) a radial wheel, with an immersion of one-tenth (·104) its diameter, overcame 9095; or, in other words, that the effects produced were as 8175 to 9095, or as 9 to 10 nearly; a result which appears to be precisely the reverse of that obtained by Mr. I. What then is the cause of the discrepancy? A reference to the table of experiments will show that the effect produced by the radial wheel goes on increasing till immersed to 0·22 its diameter; therefore the error cannot be in the small dip of the "Trident's" wheel. These experiments, it may be remarked, were made with great care, with a wheel of nearly 18 feet diameter; and although it is acknowledged that the friction of the Morgan gearing was proportionably greater than it would have been in a larger wheel, yet as the model was put together with greater care, the error from this source can be but trifling. Since, then, the discrepancy does not appear to be in these experiments, let us examine the data of Mr. I.'s paper.

The first thing that strikes us in the comparison, is the *utter* incongruity of the two examples given;—if the author had searched the whole English navy, he could scarcely have found two more unlike in every respect than those selected. One is 155 feet long, by 26 feet beam; the other 195 feet by 31. One is 6 to 1 of length to beam; the other $6\frac{1}{2}$ to 1; the tonnage of the first, therefore, is $495\frac{2}{95}$, and of the latter $860\frac{2}{95}$, U. S. measurement. One has but two-thirds the displacement of the other according to the data, and so far from there being any similarity of model, the reverse is highly probable, since the English Government is not in the habit of following any fixed rules with regard to model, except when their vessels are of the same size, or built for specific purposes. Recourse, therefore, is had by the author to calculation for the determination of their respective resistances;—and here we must be allowed to object to his method of computing the values of these data. As nearly as his meaning can be ascertained, he assumes the hull resistances to be in the ratio of the squares of their midship sections divided by their displacements. *Why* this rule is selected, we are not so clearly informed; and it is easy to show such a method of arriving at the truth a *very* incorrect one.

The hull resistance of a vessel is composed of two elements;—one, the friction of the water against the sides and bottom; the other, a certain fraction (whose value depends on the perfection of the model) of the resistance experienced by a plane surface of the same area as the midship section, moving at an equal speed in a direction perpendicular to its plane. The first of these elements is proportional to the mean perimeter of all the immersed sections multiplied by the mean length of the vessel; and the second, of course, to the midship section itself,—both also varying with the squares of the velocities. It is evident, that, as the value of the "fraction" spoken of is dependent on the fineness of the lines, it may vary greatly with the same displacement; we are, therefore, not warranted in allowing this latter element to enter at all into our calculation. Here then will probably be found one of the great causes of error,—that the resistance (that

most important point) is erroneously estimated by Mr. I., thus vitiating all his conclusions in a practical point of view.

We might stop here, but there is another point to which attention should be called. It will be observed, that, in his calculation of *powers*, Mr. I., instead of deducting only the slip, and the power required to work the air pump, &c., thus leaving the whole available powers of the engines to be compared with each other, and with the effects produced, (the friction being of course proportional to the load,) has deducted *also* the (calculated) elements of oblique action in one wheel, and reaction in the other, which, being precisely the causes of economical difference between the two kinds of wheel, are precisely those which should have been left to be determined by the results of the comparison; so that, in fact, the only thing really proved by that comparison, as made by him, is, that either his *powers* or his *effects* are erroneously calculated.

If this be not the case, where does the difference go? to what is owing the ratio of 1·000 to 0·9055? The author first calculates the *respectively* disputed elements—deducts them from his powers, thus *reducing the wheels to an equality* in effect; and then, because the powers so obtained do not correspond with the resistances he has calculated, we are told that the difference is owing to the respective values of the two wheels.

After thus endeavoring to point out the causes of error in some of the conclusions deduced from the practical part of Mr. Isherwood's paper, we desire to say a few words about his theory. The whole matter has been before so ably discussed by English and other engineers, that, in truth, little remains for more modern writers than to sum up what has been already said.

It has been acknowledged by the most sanguine advocates of Morgan's wheel, that, even theoretically considered, it is more valuable than the ordinary form *only* in deeper immersions than ·235, or about one-fourth, of the diameter of the wheel,—which, as Mr. Isherwood confesses, and as we all know, is rarely exceeded, even by vessels going out of port for a two weeks' voyage, and *never arrived at* in American sea steamers which are fitted with larger wheels than the generality of European vessels. When this wheel was first brought before the English public, its inventor and friends, overlooking the very important fact, that, in a vessel in motion, the action of the wheel is very different from that of the same wheel while the vessel is at rest; and that in fact, the vertical position of the float is, in the common wheel, so far from being the best, as would *a priori* be supposed, absolutely the *worst* for propelling purposes;—overlooking, we say, these facts, magnified the importance of the advantages possessed by Morgan's wheel, in which the floats are always vertical, and the central position that most advantageous in propulsion. From this difference it results that the amount of surface in *one float* of Morgan's wheel must be nearly as great as that of all the floats immersed in the common wheel, in order to involve as little slip. This being incompatible with the advantage claimed, of less space occupied by the former in the width of the vessel, it is generally found to give a greater slip than the radial wheel, and consequently to involve a greater expenditure of fuel in order to drive a vessel at the same speed. A case might be adduced in which, upon the trial of two English steamers, built, with this exception, (the form of wheel,) pre-

cisely alike in every respect, it was found that, to attain the same speed, the Morgan wheel had to make two more revolutions per minute than the other,—of course involving a greater consumption of fuel.

We do not desire to underrate the value of the new wheel; it undoubtedly enters and leaves the water with less shock than the other, may be made somewhat narrower, (though not to the extent asserted by Mr. I.,) to produce the same economical effect, and is more efficient at deeper immersions than one-fourth its diameter, which advantage rapidly increases after that point. On the other hand, however, it is much more expensive at first, more wasteful in fuel at ordinary immersons, has greater wear and tear, and increased liability to get out of order, consequent to the severe shocks it undergoes at sea, and to the want of attention bestowed upon it during a long voyage, besides the increased friction brought upon the engine by so many more working parts.

To a due consideration of these circumstances is probably owing the slow progress hitherto made by Morgan's wheel in the favor of British engineers; for it is not to be denied that, in their practice at the present day, its use forms the exception and not the rule. But, whatever be its popularity with them, the reasons opposing its introduction into our own steam marine cannot but possess weight with those interested in its economy, particularly when it is remembered that the peculiar construction of American steamships, differing as it does in many important points from that of European vessels, forbids an application of the same standard to both, and that what might be called an improvement in one, would, from this cause, be entirely inexpedient in the other. M.

Report on the Explosion of the Locomotive Engine "Erie," on the Western Railroad, on the 29th June, 1850.*

BOSTON SOCIETY OF CIVIL ENGINEERS,
August 5, 1850.

The undersigned, appointed at the monthly meeting held July 1st, 1850, to examine into the facts connected with the recent explosion of a locomotive engine on the Western Railroad, on the 29th of June last, having attended to that duty respectfully submit the following report:—

On Wednesday, the 3d of July, the Committee went to Springfield, and there examined the engine as it stood in the engine house. It was stated to the Committee that the machine was in the same situation it was in when brought to Springfield after the explosion.

Description of the Engine.—This engine, named the "Erie," was built by the Taunton Locomotive Company for the Western Railroad, and was placed upon that road April 3d, 1848, since which time it has been in use on freight trains.

The class it belonged to is known as the "20-ton engines," with four drivers. It was built for a freight engine, in the usual manner of building such kind of engines at those works.

The iron forming the shell of the boiler was $\frac{3}{8}$-inch plate throughout, stayed in the manner then in common use at that manufactory. The braces,

* From the Boston Courier, August 19, 1850.

six in number at the end blown out, did not go through from end to end, but both ends were stayed by short bars attached to the end plates, and fastened upon the inside of the shell of the boiler, consequently placed on lines diagonal to the direction of the length of the boiler, and to the direction of this explosion.

The iron plates from which the boiler was made appear to be good, and of the usual thickness and quality of iron; but, to avoid mistake in this point, your committee have taken steps to have the matter settled by direct experiment upon the iron itself.*

Since coming upon the road it has run on an average with the other engines, and has had also about the average amount of repairs put upon it, as compared with other engines of its class and age. It had never met with any accident to injure it, and was considered as good an engine of its class as any on the road. It had been used altogether as a freight engine, and had, with but few exceptions always run between Worcester and Springfield.

The injury to the boiler and machine was confined to the part immediately in front of the platform, on which the engine man stands. The plate forming this end of the boiler was torn from its connexion with the other parts, and pressed downwards, and nearly covered the platform. The extent of the fracture was the width of the entire plate, and to the depth of the lower side of the furnace door, and line of the fracture following the bend in the iron, by which the edge was turned in order to fasten it to the other parts; in no case did the line of fracture follow the rivet holes, and the only variation in the line was on the lower part of the fracture, where it was torn for the distance of six inches diagonally across the sheet.

The stay-bolts were all separated from their connexions with the other part of the boiler, three remaining upon the part torn off, the others remaining attached to the main part of the boiler.

The machinery adjoining this part of the engine was broken and injured, and part of the top of the house torn off. The remaining part of the engine was but slightly injured.

After the examination of this part of the boiler, an examination was made upon the inside, but we were unable to see any indications of great or excessive heat, but as the fire remained in the furnace for some time after the explosion, it is possible the tubes may be found burned when the engine is taken apart.

The safety valves were next examined, and both found screwed down so far as to render them inoperative.

The back valve was entirely rigid, and the lever could not be moved in the least degree. The forward valve could be moved slightly, but not more than from one-eighth to one-sixteenth of an inch at the end of the lever, which would give no motion at the valve which could be of any use in relieving the boiler from undue pressure of steam. These valves, we are assured, were in the same position that they were in when the engine was brought from Clappville to Springfield.

Having examined the safety valves as they were found, the balances were unscrewed, and the caps and valves opened. The valves and seats

* The iron has not, as yet, been received in Boston.

were found in perfectly good order, and free to act if they had not been prevented by being screwed down.

A general examination was made of the rest of the machine, but nothing worth noting in connexion with the explosion was found. The tender tank was moved from its position, and somewhat injured. The whole pecuniary damage done by the explosion was estimated at $1200.

After the examination of the engine, the committee returned to Boston, and on Wednesday, the 10th instant, returned to Springfield, to get such information from the men attached to the train and others, as might serve to explain further the cause of the accident.

Mr. William Jennings, the conductor of the train, stated: "We started with this freight train from Worcester at 40 minutes past 11, A. M., on Saturday the 29th of June. The train consisted of 38 cars,—in length between 500 and 600 feet; of which five or six were platform cars, and 24 of the cars were loaded. The amount of freight was about 150 tons. This train was drawn by the "Erie,"—engine-man, John Nonnegon; fireman, Wm. Whitman. There were three freight trains started from Worcester, with the usual interval of time between,—we were the last—overtook the other trains at Clappville.

"We remained at Clappville until the other trains went on. We remained there about thirty minutes—took in wood and water, and shifted some cars on to the side track. The wood we took in at this place was white pine, and very dry. We started from Clappville, and ran up the inclined plane about one-half a mile—put down the brake and stopped between five and eight minutes.

"At the time the explosion took place, I was on the north side of the train, about two hundred feet back from the engine. Heard the signal for starting, and the engine exhaust two or three times, when I heard the report of the explosion, and found the wood from the tender falling around me. The largest part of the wood fell near where I stood; part of it was thrown as far as six hundred feet from the engine. The engine-man was thrown about two hundred and fifty feet, and killed instantly by the explosion.

"My opinion is that there was water enough in the boiler at the time of the explosion. I think so from my knowledge of the engine-man;—have known him for a year and a half, and always considered him to be a very careful man about keeping his water up. I have never known him to get his water low.

"The engine did not blow-off at Clappville, nor did I hear the steam blow-off at all. The engine-man complained that the engine did not make steam so well as formerly. We had no difficulty in drawing our loads. The engine was as competent to draw thirty loaded cars up a sixty feet grade as any other engine of its class on the road.

"The fire remained in the furnace in all about thirty minutes after the explosion, before it was put entirely out. We put in earth first to check the fire, as we could get no water; the tender tank, being broken by the explosion, let the water out, and there was no water near the place where the explosion took place.

"Mr. Moore found the safety valves screwed down hard at Clappville,

immediately after the explosion. Mr. Baker was the first engine-man who arrived at Clappville after the explosion."

Mr. Charles Moore, the assistant conductor, stated that—"I found the safety valves screwed so hard down that they could not be moved to allow the steam to blow-off. It was not more than 10 or 15 minutes after the explosion that I saw them; the rods were blackened by the explosion in such a manner that if the valves had been changed within that time it could have been detected.

"There had not been, to my knowledge, any other person upon the engine after the explosion before me. I was careful to allow no other person to get on. In my opinion there was sufficient water in the boiler at the time of the explosion. I judge so from the appearance of the cars, &c., being wet, and the fragments of clothing remaining upon the body of the engine-man were wet with water."

William Whitman, fireman, stated—"I stood by the side of the engine in the act of getting on when the explosion took place. My clothes were wet with water, and I was badly scalded by it. When we started from Clappville I filled the furnace with wood; there was no more wood put in until the explosion took place. The wood was very dry and burned freely. The engine blew off a very little from the back scale; none from the forward one. Could just hear the escape steam as I stood by the side of the engine. I had been with this engine-man one and a half years; never knew him to get his water low; have known him to get too much in; he did so once that day. He was a careful and temperate man, so far as I know. He was in the habit of changing his balances on the different grades,—screwing them down when working up a heavy grade, and raising them up on levels and down grades. Never heard him make any remarks that the engine was weak or out of repair."

Mr. James Baker, engine-man of passenger trains, stated—"I was the first engine-man at Clappville after the explosion. It was about three hours after it took place. I found the back valve tight down; it could not be moved at all. The forward valve lever could be moved a little—about one-sixteenth of an inch. The screws were not altered when the engine was brought to Springfield.

"I judge that there was a sufficient supply of water in the boiler, from the appearance of the tender and cars,—the water from the boiler being somewhat muddy, and leaving its marks upon them.

"Running passenger trains, I never alter my scales (balances). When I used to run freight trains, I was in the habit of altering them upon different grades.

"I noticed that, on the day this explosion took place, the engines made steam very freely. The scales are weighted to about 150 pounds to the square inch."

From this examination, your committee are of opinion that the immediate cause of this explosion was the condition of the safety valves, which (through carelessness or inadvertency) were screwed so closely down as to be entirely inoperative, and thus rendered the boiler a close vessel, with no power to relieve itself from undue pressure but by explosion. The witnesses all agree upon this point.

The escape steam, mentioned by the fireman, must have been very

slight, as he stated he could but just hear the escape as he stood by the side of the engine, and it probably came from a slight leak at the valve.

From the statements of the men near the train, and from the appearance of the tender, which we saw ourselves, we are of opinion that there was water enough in the boiler at the time of the explosion, and *consequently it was not occasioned by a deficiency of water in the boiler.*

In regard to the strength of the boiler, the committee believe that it was sufficient for the usual working pressure of steam, but had not a proper *excess* of strength; and they think proper to recommend that the system of using short stay-bolts only, for the heads of boilers, should be discontinued, and that there should be always added to them long bolts passing through from end to end, as, in their opinion, the additional security against accidents from undue pressure will more than compensate for any inconvenience which may be experienced in the boiler by their introduction. This system has been adopted by the parties who built the "Erie," since the construction of that engine.

They would also again recommend, as was done in the report upon the explosion on the Eastern Railroad, that the balances attached to the valves should be so arranged that it should be out of the power of the engine-man to place them in the condition of those found upon the "Erie," as being the only simple and safe prevention of such accidents, whether arising from want of discretion or from ignorance.

WALDO HIGGINSON.
WM. P. PARROTT.
J. H. BLAKE.

Report of PROF. CHAS. G. PAGE, *upon Electro-Magnetism as a Moving Power.**

The Secretary of the Navy on Tuesday sent to the Senate, in answer to their call for information, the following report from Professor Charles G. Page, being an outline only of his experiments in the application of electro-magnetism:—

WASHINGTON, *August* 30, 1850.

SIR: In compliance with your request, I have the honor to report to you the progress made in my experiments, under the act of March 3d, 1849, appropriating $20,000 for "testing the capacity and usefulness of the electro-magnetic power as a mechanical agent for the purposes of locomotion and navigation, and the probable cost of using the same."

A schedule of expenditures incurred up to this date, amounting to $12,667·28, is herewith annexed, by which it will appear that considerably more than one-third of the appropriation remains yet unexpended. Outstanding bills remain amounting to about $1000, most of which is charged at the Navy Yard for material, which, when deducted, will leave about one-third of the appropriation for further prosecution of the experiment.

From the brief time allowed, it will be impossible for me to do more in this report than to give an outline of the experiments which I have repeated

* From the Washington National Intelligencer, September 5, 1850.

and recorded during the past year. Their full detail and explanation will form a volume replete with interesting scientific matter, and require much time and labor.

The first principal experiments were made with a small trial engine, built expressly for the purpose, and with the utmost care in reference to mechanical accuracy. Attached to this was a dynamometer of new construction, and admirably adapted to the purpose. This was invented by my principal engineer, and measured in a most satisfactory manner the dynamic power of the engine at any given velocity—a great desideratum in estimating this new power. With this trial engine, the following important questions were tested:

1. The dynamic values of different qualities of soft iron.
2. The dynamic values of steel,—hard and soft.
3. The dynamic value of cast iron.

The statical values of all these varieties were tested by a separate apparatus constructed for the purpose, called the axial galvanometer. Twelve varieties in all were tested, and were in bars of uniform size, one foot in length, and one inch in diameter, and it was found that the statical and dynamic properties corresponded.

4. The proportions of the helices were approximately tested; though much remains unsettled yet upon this important point.
5. The advantage of keeping up the magnetism in the axial bar was most satisfactorily tested.
6. Various modes were tried of reversing the motion of the engine, and with success.
7. Various kinds of cut-off (which is the most critical and important point in the construction of the engine) were tried.
8. The operation of closed circuits and secondary currents was tested by a number of experiments, requiring great care and accuracy.
9. The best working velocity of this engine, and its absolute power with a given battery, was fully tested.
10. The ratio of the increase of power, with an increase in the quantity of the current.
11. The values of different kinds of metal in forming the cut-off.
12. Various mechanical points of construction, supposed to have been incompatible with the exhibition of this power, were put to a practical test.

Various other minor points also were the subject of experiment, which will be communicated hereafter.

A second model, of small size and somewhat rude construction, was also made, with a view of testing a new arrangement of the axial bars.

Experiments were then commenced upon a larger scale, with a view to determine whether the same proportion of power could be obtained from large as from small engines, this being the principal question in view at the time of the grant of the appropriation.

With a view to facilitate the construction of helices of large size, a machine which had long been in contemplation was made at a considerable expense. The work was done at the Navy Yard in a creditable manner, and the machine performed its work well, turning out entire helices of copper wire, of large size, from straight bars. But before I had proceeded

far, a discovery was made in reference to the helix which rendered the machine useless, for the present at least.

A number of large helices were then constructed of various sizes, and suitable bars of soft iron prepared, corresponding to the helices. Hollow and solid bars were prepared, from two inches to eight inches in diameter, and generally three feet in length. Some bars of four and five feet in length were also prepared. The bars were all worked at the Navy Yard, and at a considerable expense, as they were required to be of homogeneous metal, accurately turned and bored.

With these bars and helices a multitude of experiments were performed and recorded, and these were kept up day after day for about two months. My official duties as Examiner in the Patent Office left me only the evening of each day for operation; and, under such circumstances, you will readily appreciate the difficulties and disadvantages under which I have labored. My own zeal has led me beyond my strength; but I have been richly rewarded by the most flattering results.

The experiments here were not such as could be performed upon the laboratory table; but were with large masses of iron, weighing in some cases three hundred pounds, and helices sometimes twice that weight.

Adhering to the same size of battery through a long series of experiments, and varying the coils and bars, I found, to my great gratification, that as I increased the dimensions of each a corresponding increase of power was exhibited, and the consumption of material, or cost of the power, in some proportion diminished. These results were encouraging and stimulating in the highest degree, and fully justified the undertaking at once, of an engine upon a much larger scale than any hitherto tried.

This engine, the framework of which was principally built at the Navy Yard, was an upright engine of two feet stroke; and in order to have facilities for comparative trials and experiments, it was necessary that a double engine should be made, the two parts exactly corresponding. Two bars of soft iron, six inches diameter and three feet in length, were the prime movers, and these were balanced by means of connecting rods and cranks upon a fly-wheel shaft. The balance wheel and shaft together weighed six hundred pounds. When this engine was first tried, with the same battery which had before given me one-fifth of a horse power, with a smaller engine, it produced only one-third of a horse power. By careful attention to the adjustments, and particularly to the cut-off, which was a very different thing now from what it had been in smaller engines, the engine soon yielded one horse power. Here was a gain of eighty per cent. as measured merely by the size of the battery. But it was much more; for the cost was found to be less for one horse power than it had been before for one-fifth of a horse power, in a smaller engine; how much less has not yet been ascertained.

A great variety of experiments were continued with this engine, to be hereafter detailed, each having a definite object; and, I am happy to say, each resulting advantageously, so that finally, by little daily increments, I obtained from this engine, by a trifling addition of battery, a full two horse power.

By way of giving a practical character to the engine, it was geared to a circular saw ten inches in diameter, the turning lathe and grindstone of

the workshop, all of which it worked simultaneously, as witnessed by a number of visiters, and, if I mistake not, by your predecessor in office, in company with Lieut. Maury, of the National Observatory.

After many satisfactory trials with this engine it was taken down, and all its available parts used in the construction of the single horizontal engine which I had the honor lately to exhibit before the Smithsonian Institution. This change was made for the purpose of dispensing with the dead weight of one of the driving bars, and more particularly for introducing the important feature of keeping up the magnetism of the driving bar. As soon as this new form was completed and tried, a gain of one-half horse power was at once realized, and by the addition of a few more feet of battery surface, the power was found to be above four horse. Further addition of battery would still augment the power, and I see no reason why ten horse power might not be obtained from this engine by the addition of more battery; but whether it would be economical to increase power by this means alone, and to ascertain the point, for this and every other engine, beyond which economy would cease, by increasing the battery alone, are matters to be determined by experiment.

The next most important point to be determined was the expense of this power. Much to my own surprise and gratification, the expense was found to be less than the most expensive steam engines; although recently, in Europe, it has been decided by experimenters and men of science, and generally conceded, that it was fifty times the cost of the dearest steam engines. It is still, however, considerably dearer than the cheaper sort of steam engines; but this is no obstacle to its introduction, considering its immense advantages in other respects. Moreover, if thus much has been done in the very inception of this undertaking, what may we reasonably expect from its further prosecution?

Before it can be rendered available in practice much remains to be done with the galvanic battery, to render its action regular and durable, and in other ways to establish a certainty of action, so that the engines may be managed by persons not thoroughly skilled in the subjects of electricity and magnetism.

It remains yet also to be proved whether the power will increase in proportion to the size of the engines. This principle seems to be strongly indicated by past experiments, but yet it cannot be established by calculation or process of reasoning. Experiment upon an extensive scale can alone determine this point. A part of the work preparatory to building a locomotive engine has been done; but it seems necessary to try further experiments before incurring the expense of another large engine upon the plan above mentioned. The rotary form of the engine has not yet been tested, although it possesses advantages not to be found in any form of the reciprocating engine. There are some obvious disadvantages attending its construction; but it is hoped that they will be outweighed, more especially as this form of the engine will occupy less than one-half the room required for the reciprocating form.

It would seem very desirable that the investigation thus begun, and so far successfully conducted, should be carried at least beyond *an uncertain issue*, and that *every important point* should be settled, and particularly that of its availability on an extensive scale. The power is peculiarly

fitted for purposes of navigation, if it can be made subservient; and a trial upon a scale of 100 horse power seems to be the only mode of arriving at a definite conclusion upon this point. It is obvious that, preliminary to such an undertaking, a great many experiments will be absolutely necessary; and such only as one quite familiar with the difficulties of entering upon an entirely new field of operation can properly appreciate.

In conclusion, I beg leave to refer you to the enclosed report of a debate before the American Scientific Convention recently held at New Haven, (See *Nat. Intel.*, Aug. 29,) which will indicate the opinions of men of science upon this all-important subject.

I have the honor to be most respectfully, your obedient servant,

CHAS. G. PAGE.

HON. WM. A. GRAHAM,
Secretary of the Navy.

Note.—The expenditures under the appropriation were placed by the act making it under the supervision of the Secretary of the Navy; and, we understand, were made only upon bills approved by the head of that department, which are filed as vouchers in the proper office. No compensation whatever is allowed to Professor Page for his services in making the experiments, nor for the great amount of scientific knowledge he has to aid him in carrying out the provisions of the law.—*Eds. Nat. Intel.*

On Resin and Water Gas. By ANDREW FIFE, M. D., *Professor of Chemistry, King's College University, Aberdeen.**

Though, during the course of the last year, I had been engaged in conducting experiments on water resin gas, I did not think it necessary to make the results public, because, after what had been stated in scientific journals, I had thought that the proposal to introduce this gas, for the purpose of illumination, had been abandoned. The very remarkable statement advanced in the Journal for April last by Mr. White, patentee for a process of manufacturing the gas, shows, however, that this is not the case; but that, on the contrary, he still maintains not only that the process is an economical one, but also that the gas afforded is of high illuminating power, and consequently that it is cheaper than other gases are as a source of light. The appended remarks in the same number of the Journal, are sufficient proof of the inaccuracy of some of Mr. White's statements, and of the little prospect there is of water resin gas, *as manufactured by him*, coming into use, especially in those places where coal is to be had at a reasonable price; I trust, however, notwithstanding what has been already advanced regarding the process, that the few observations which I am now about to submit, the result chiefly of experiments, will not be deemed valueless. I give them because it is a subject of such vast importance that I consider it to be the duty of every one who has any information regarding it to make it public; and then to allow those who are qualified to judge to say whether attempts to introduce this gas, as an economical source of light, ought still to be persevered in.

* From the London Mining Journal, No. 779.

It is well known that when water is passed over iron at a red heat, excluded from air, it is decomposed; oxide of iron is formed, and hydrogen gas is evolved, the purity of which depends on the kind of iron employed. Were the iron clean and pure, then pure hydrogen would be the result; but this very seldom occurs in practice, because not only does the iron contain foreign ingredients, but it is soiled also by the hands and tools of the workmen in the factory from which it is procured, in the state of filings or turnings. Hence it is that the specific gravity of the gas which it yields is considerably beyond that of pure hydrogen, and the appearance of the flame is different. The light afforded is extremely faint.

When water is passed over carbon, either as coke or charcoal, at a red heat, and excluded from air, decomposition ensues, and a gaseous fluid escapes, with regard to the nature of which different opinions have existed. It was at one time supposed to be, and indeed in works on chemistry it has been described as, a mixture of a variety of gases, the principal of which is light hydro-carbon, better known as *marsh gas*, *coal mine gas*, and *fire-damp*. More recently performed experiments, however, have proved that it does not contain hydro-carbon, or at most but a trifling quantity of it. In a paper published by me in the *Edinburg Philosophical Journal*, July, 1837, it is shown that the gas produced by this process is a mixture of hydrogen, carbonic oxide, and carbonic acid, the proportions varying according to the heat and other circumstances. In these trials I found that the carbonic acid was about 18 per cent. After removing it, the remainder was of specific gravity 470, and consisted of a mixture of hydrogen and carbonic oxide in about equal proportions. By combustion it yielded carbonic acid and water, the light afforded being extremely feeble. As the gas, after the removal of the carbonic acid, was of specific gravity 470, it must have been, before its removal, of specific gravity about 660.

Allowing the correctness of the results now stated, it is evident that when water is brought into contact with iron and carbon at a red heat, in the same vessel, the gas evolved will be either hydrogen alone, provided the whole of the oxygen unites with the iron, or it will be a mixture of hydrogen, carbonic oxide, and carbonic acid; the proportions varying according to the surface of carbon and iron exposed, and to the facility with which the vapor of the water is brought into contact with the one or the other. Of course the specific gravity will also vary according to circumstances. I have already said that both carbonic oxide and hydrogen burn with a very feeble flame, and give very little light. The appearance of the flame of the mixed gases will, of course, vary according to the proportions.

The following experiment was made with the view of ascertaining the illuminating power of the gas prepared from water, by the process recommended by Mr. White, though not exactly with the same arrangement. The retort used was the one which I employed in my trials with coal gas, previously recorded. It was stuffed with charcoal and scrap iron, which were brought to the proper temperature after the door of the retort was secured. Water was then allowed to flow in, the supply being regulated by a stop-cock. The gas given off was measured in the usual way. From 7½ lbs. of water 59½ cubic feet of gas were evolved, the specific gravity of which was 574. By lime-water the condensation amounted to 16·5 per

cent., indicating, therefore, that quantity of carbonic acid; that is, about $\frac{1}{6}$th of its volume. Had the specific gravity been taken after abstracting the carbonic acid, it would have been found to be very nearly the same as that formerly mentioned, that is, between 470 and 500. The gas burned with a very feeble bluish flame, yielding carbonic acid and water. With a flame five inches long, from a jet with an aperture of $\frac{1}{33}$d of an inch, the consumption was one foot in 32 min. 30 sec., that is 1·84 feet per hour.

The illuminating power was tried by the method described in No. 6 of this Journal, using the argand with 56 holes, having a button to spread the flame. The standard light was a wax candle, six to the pound, consuming 140 grains per hour. The argand burned one foot in 5 min. 50 sec., that is, very nearly 10 ft. per hour. The spot on the Bunsen screen disappeared when the distance between it and the candle was 40 in., and that between the screen and the gas-burner was 6 in. and $40 \times 40 \div 6 + 6 = 44$. The wax candle was, therefore, giving 44 times as much light as the burner consuming 10 feet per hour, evidently showing that water gas, thus manufactured, is valueless for the purpose of illumination. This trial of the illuminating power was made on the gas without having abstracted the carbonic acid, which, it has been stated, amounted to upwards of 16 per cent. This, I would say, is a defect in the process for procuring water gas as originally introduced by Mr. White, and hence in all probability, the cause of the great specific gravity of the gas as stated by him. Had the gas been freed from carbonic acid, *as it ought to have been*, by putting it through lime purifiers, the specific gravity would have been much less; but this would not only have diminished the quantity evolved from a given weight of material, but also would have reduced materially the specific gravity, which it is of consequence to have as high as possible, when specific gravity is given as a test of the illuminating power. This also shows the extreme absurdity of putting any confidence in specific gravity alone, as a test of the value of a gas for the purpose of illumination.

Before leaving this part of the subject, I may advert to an opinion entertained by some, viz., that durability alone is a good indication of the value of gas. In this instance the durability was 32 min. 50 sec. That of the gas from the best English caking coal I have formerly stated to be 50 min., and that from an average Scottish Cannel coal to be 60 min. By the most advantageous modes of combustion, 10 feet of the English gas gave the light of 27·3 candles; of the Scottish gas, the light of 60 candles; while the same quantity of water gas gave that of only $\frac{1}{4\frac{1}{4}}$th of a candle. The illuminating power and durability, therefore, bear no proportion whatever to each other; consequently, durability alone gives no indication of the illuminating power of gases.

The next set of experiments was made on resin, with the view of ascertaining the quantity and quality of the gas which it affords, by decomposition at different degrees of heat. The resin was melted cautiously, and poured into the reservoir connected with the retort, previously brought to the same heat as that requisite for the manufacture of coal gas. By a proper contrivance, it was kept warm and sufficiently fluid to enable it to flow easily; 6 lbs. 2 oz. yielded 61 feet of gas, that is, very nearly 10 feet from the pound. The gas was of specific gravity 640. Lime-water in-

dicated 10 per cent. of carbonic acid. With a jet $\frac{1}{33}$d of an inch in diameter, and a 5-inch flame, the durability was 50 min., that is, 1·2 ft. per hour. By the photometer the jet gave the light of 2·2 candles per foot. The argand with 56 holes, consuming 5 feet per hour, gave the light of 2·45 candles per foot.

This gas being of a specific gravity 640, a cubic foot would weigh 343 grains. The gas, therefore, in all, weighed nearly 3 lbs.; consequently upwards of one-half of the resin employed was wasted by the deposit of carbon in the retort, and by the distillation of volatile oil.

A second trial was made with the retort at a dull red heat: 2 lbs. 8 oz. of resin gave 16½ feet of gas of specific gravity 657, and containing 6 per cent. of carbonic acid. This is equal to 6·2 feet per pound of resin. The durability, with a jet $\frac{1}{33}$ of an inch in diameter and 5-inch flame, was 48 min., that is 1·25 feet per hour. With the jet flame the light was that of 1·68 candles per foot; with the argand it was that of 2·27 candles per foot. The specific gravity of this gas being 657, a cubic foot would weigh 352 gr., which would make the total quantity be 5888 gr.; the resin employed was 18,664 gr., consequently, two thirds of it had disappeared as deposited carbon and volatile oil.

A third trial was made with the heat rather higher than in the second, but lower than in the first experiment. 7 lbs. 6 oz. of resin gave 64 feet of gas of 419 specific gravity, and containing 8 per cent. nearly of carbonic acid; that is, equal to 8·42 feet per pound of resin. With the jet the durability was 41 min. 40 sec., that is, 1·43 feet per hour. In this case the loss also amounted to upwards of one-half of the resin employed.

A fourth trial at nearly the same heat was made: 6 lbs. of resin afforded 55 feet of gas of 613 specific gravity; that is, rather more than 9 feet per pound. In this case the loss amounted to upwards of one-half of the resin. Of these four trials, the first is by far the best, not only as to quantity, but also as to quality of the gas afforded, a pound of resin having yielded 10 feet of gas, the illuminating power of which was equal to that of 2·45 candles per foot. This is very nearly the same as that of the best English caking coal gas, to which I alluded in No. 9 of the *Gas Journal*.

From the above trials, it would appear that during the conversion of resin into gas there is a considerable loss. I was anxious to ascertain whether this was owing to any imperfection in the apparatus, or whether it always accompanies the decomposition. I was fortunate in having an opportunity of putting this to the test, by having been obligingly offered the use of an apparatus erected under the superintendence of Mr. White himself, for the purpose of supplying water resin gas, according to his patent process, to a private dwelling house. The apparatus was a very small one, consisting of two retorts, the one vertical, for the decomposition of water, the other horizontal, for the decomposition of resin. In the following trial the resin retort only was used:—5 lbs. of resin, cautiously melted, afforded 44 feet of gas of 574 specific gravity, that is, 8·8 feet per pound. The per centage of carbonic acid was not ascertained. From the low specific gravity it was, perhaps, not great. The condensation by chlorine was 8. The durability with the jet and 5-inch flame was 53 min. 20 sec., that is, 1·12 ft. per hour. With this jet, the light was that of 1·14 candle per foot. Owing to a deficiency of pressure on the gasholder, I

could not get a sufficient supply of gas to enable me to ascertain the illuminating power by the argand. I could not make it consume beyond 3 ft. per hour, which was too small a quantity to have profitable combustion. I have previously shown that, for the consumption of equal quantities, the light given by a good argand is to that given by a jet as about 1·8 to 1. Giving this gas, then, every allowance, the illuminating power by the argand could not exceed that of 2 candles per foot.

To be continued.

For the Journal of the Franklin Institute.

Marine Steam Navigation for 1850.

It is now some thirteen years since the "Great Western" first made her appearance in the harbor of New York, and in her we obtained our first correct ideas as to what an ocean steamer should be. Previous to her arrival all our sea steamers (coasters) were of a mixed nature,—a compound of river and sea steamer combined, making fair vessels for good weather, but showing their lack of sea qualities in heavy storms. A few years sufficed to show us that something quite different was wanted, even for our coast, but it was some time after the arrival of the "Great Western," and when she had been in the trade for several successive seasons, making her trips to Liverpool and back with great regularity, before any progress was made, or even the first attempt to build a regular sea steamer for commercial purposes, (although the Government built the "Missouri" and "Mississippi" steamers in 1841.)

It was about 1846 that the steamer "Southerner" was built, to run between New York and Charleston, S. C. She was after the English model so far as general appearance was concerned, but differed from them in her internal arrangements. Her length was 180 feet on deck, 30 feet beam, 14 feet hold, 716 tons; with one side lever engine, built by Stillman, Allen & Co., New York, with cylinder 68 inches diameter and 8 feet stroke. She was very successful, and is still in the same trade.

The ground once broken, each year produced several sea steamers, some of which had defects of a serious nature, caused by a want of experience in that department of engineering. Passing over the intervening years we reach the present, which, from the large number of steamers built, and their great success, will go far to put us on an equality, if not actually ahead, of Great Britain, our only rival.

Below I give you an account of all the *sea steamers* built or building during the year 1850.

In New York, amounting to 37,540 tons, as follows—

"Atlantic," Liverpool steamer, 290 feet long, 46½ feet wide, 32 feet hold, 3000 tons; two side lever engines, cylinders 95 inches diameter, 9 feet stroke, built by Stillman, Allen & Co.

"Pacific," Liverpool steamer, same size and model as the "Atlantic;" engines also the same size, and built by the Allaire Works.

These vessels are the fastest sea steamers afloat, making better time than

the "Asia," although they are of equal power, and the "Asia" is 500 tons the smallest.

"Arctic," Liverpool steamer, hull same size as the "Atlantic;" engines have the same diameter of cylinder but one foot more stroke, and are built by Stillman, Allen & Co.

"Baltic," Liverpool steamer, same size at the "Arctic;" engines built by the Allaire Works.

"Franklin," Havre steamer, 250 feet long, 26 feet hold, and 40 feet beam, 1900 tons; two side lever engines, cylinders 93 inches diameter and 8 feet stroke, built by Stillman, Allen & Co.

"Humboldt," Havre steamer, 280 feet long, 40 feet beam, and 28 feet hold, 2200 tons; two side lever engines, cylinders 95 inches diameter, 9 feet stroke, built by Stillman, Allen & Co.

"Columbia," Pacific steamer, 800 tons; two side lever engines, size unknown, built by Stillman, Allen & Co.

"Florida," Savannah steamer, 200 feet long, 32 feet beam, 21 feet hold, 900 tons; one side lever engine, cylinder 75 inches diameter, 8 feet stroke, built by Stillman, Allen & Co.

"———," Savannah steamer, of same size, and by same builders.

"———," Pacific steamer, 225 feet long, 40 feet beam, 20 feet hold, 1700 tons; two oscillating engines, by Stillman, Allen & Co.

"———," Charleston steamer, 200 feet long, 32 feet beam, and 21 feet hold, 900 tons; one side lever engine, 70 inches diameter of cylinder, and 8 feet stroke, by Stillman, Allen & Co.

"———," Pacific steamer, 220 feet long, 36 feet wide, 24½ feet hold, 1360 tons; one side lever engine, by Stillman, Allen & Co.

"———," Pacific steamer, 225 feet long, 40 feet beam, 20 feet hold, 1700 tons; two oscillating engines, by the Allaire Works.

"———," Charleston steamer, 212 feet long, 34 feet beam, 22 feet hold, 1170 tons; two side lever engines, cylinders 60 inches diameter, 7 feet stroke, by the Allaire Works.

"———," Liverpool (propeller) steamer, 2000 tons, propeller 15 feet diameter, engine by the West Point Foundry.

"———," Pacific steamer, 230 feet long, 31 feet wide, 19 feet hold, 1070 tons; one beam engine, cylinder 70 inches diameter, 10 feet stroke, by H. R. Dunham & Co.

"———," Chagres steamer, 230 feet long, 31 feet beam, and 23 feet hold, 1070 tons; two beam engines, cylinders 50 inches diameter and 10 feet stroke, by Cunningham & Belknap, Phœnix Foundry.

"———," Texas steamer, 215 feet long, 33 feet beam, and 19 feet hold, 1100 tons; one beam engine, cylinder 56 inches diameter, 10 feet stroke, by the Morgan Iron Works.

"———," Texas steamer, same size and same builders.

"North America," Pacific steamer, 255 feet long, 34½ feet beam, 22 feet hold, 1470 tons; one beam engine, cylinder 60 inches diameter, 12 feet stroke, by the Morgan Iron Works.

"San Francisco," Pacific steamer, 250 feet long, 40 feet beam, 24 feet hold, 1900 tons; two side lever engines, by the Morgan Iron Works.

"———," Pacific steamer, 220 feet long, 35 feet beam, 14 feet hold,

1300 tons; one beam engine, 72-inch cylinder, 11 feet stroke, by the Morgan Iron Works.

"———," Liverpool (propeller) steamer, 210 feet long, 32 feet beam, 26 feet hold, 1000 tons; two engines, connected direct to propellor shaft, cylinders 50 inches diameter and 44 inches stroke, diameter of propeller 14 feet, by Hogg & Delamater.

In Philadelphia 3807 tons, as follows:—

"Philadelphia," Chagres steamer, 190 feet long, 33 feet beam, 18 feet hold, 975 tons; two side lever engines, cylinders 56 inches diameter, 6¾ feet stroke, by Merrick & Son.

"Constitution," Pacific (propeller) steamer, 180 feet long, 26 feet beam, 18 feet hold, 570 tons; two direct acting engines, cylinders 34 inches diameter, 34 inches stroke, propeller 10 feet diameter, by I. P. Morris & Co.

"Union," Pacific (propeller) steamer, of same size; engines by Reaney, Neafie & Co.

"Pampero," Pacific steamer, 140 feet long, 26 feet beam, 10½ feet hold, 357 tons; one inclined engine, cylinder 50 inches diameter, and 6 feet stroke, by Reaney, Neafie & Co.

"———," Pacific (propeller) steamer, 153 feet long, 24½ feet beam, 17 feet hold, 435 tons, two engines geared 2 to 1, cylinders 24 inches diameter, 2 feet stroke, by Sutton & Co.

"———," Charleston (propeller) steamer, 180 feet long, 27 feet beam, 18½ feet hold, 600 tons; two oscillating engines geared 1¾ to 1, cylinders 40 inches diameter, 40 inches stroke, propeller 10 feet diameter, by Sutton & Co.

"———," Venezuela Navy, 138 feet long, 23 feet beam, 10 feet hold, 300 tons; two direct action engines, cylinders 25 inches diameter, 24 inches stroke, propeller 7 feet diameter, by Sutton & Co.

In Baltimore,—

Steamer "Monumental City," (propeller,) 175 feet long, 30 feet beam, 15 feet hold, 750 tons; two oscillating engines, cylinders 44 inches diameter, 3 feet stroke, one 4-blade propeller, 12 feet diameter, by Murry & Hazlehurst.

Being a total of 42,097 tons, all of which could be used for naval purposes if desired. B.

For the Journal of the Franklin Institute.

On the Economical Application of the Waste Gases from Blast Furnaces.

By Hu. L. Damsel.

The economical application of the waste gases from blast furnaces has engaged the attention of several iron-masters in the South Wales iron-making district during the last twelve or eighteen months, and not a few of them have expended large sums in their endeavors to turn these otherwise useless products of combustion to profitable account. The results of their experiments (which have been conducted at an immense cost—in some instances exceeding £10,000) are so very different, however, from what the promoters of the measure anticipated, that a brief outline of the

facts brought to light may not be wholly uninteresting to the proprietors of similar establishments in Pennsylvania and adjoining States.

The experiments have proved, beyond a doubt, what was well known on the continent of Europe, namely, that, by attention to the manner of collecting, conveying, and applying the gas to the boilers, the blowing engines can be worked without the employment of coal fires. But it is found that the heat given out by the ignited gas is much inferior, both in quantity and intensity, to that from coal fire, and that two boilers with fires will generate as much steam as three with the gas apparatus. From this it will be apparent that, with the gas, an increased number of boilers are required, entailing a large outlay of capital in addition to that expended on the apparatus for the collection and conveyance of the gases. This large expenditure of capital, however, would be no obstacle to its permanent adoption by the large Welsh proprietors if the saving of fuel was real instead of being, as it is in practice found to be, imaginary.

It is found that, with the abstraction of the gaseous products of combustion, a larger quantity of fuel is required in the blast furnace to smelt a given weight of iron-stone. This increased consumption, while it is in no one case less, is in some greatly in excess of the saving effected by the use of the gas at the engine fires and hot air stoves. In addition to this increased consumption of coal in smelting, the plan is attended with the further disadvantage, that, immediately on the application of the apparatus for the abstraction of the gases, the make of the furnace is largely reduced. Furnaces which formerly produced 150 and 160 tons per week, now produce only 120 to 130 tons, although, in all other respects, working under precisely similar circumstances.

These are the principal disadvantages, but others of scarcely less importance are found to attend the plan. Among these may be mentioned great irregularity in the working of the furnace. "Scaffolding," or a jamming together of the materials in the body of the furnace, so as to form an arch, the gradual descent of the matèrials under which ultimately occasions a large cavity to be left, is of frequent occurrence with the gas furnaces. Persons conversant with the economy of an iron-works well know how very important it is that the materials charged into the mouth of the blast furnace should descend regularly and uninterruptedly, and the trouble and annoyance occasioned when it is otherwise.

This scaffolding of the materials in the interior of the blast furnace, and their subsequent sudden descent of several feet at a time, forms one of the greatest obstacles to the successful application of the plan. That this may be the better understood, it will be necessary to mention that the gas is collected by sinking into the mouth of the furnace (so that its upper end be level with the charging plates) a wrought iron tube or cylinder, five or six feet deep and six or eight inches smaller in diameter than the furnace mouth. In the ordinary course of filling the furnace this cylinder is kept full of materials, but around the exterior of that portion below the mouth of the furnace an annular chamber is formed by the space between it and the interior of the furnace; from this chamber the gas is collected by means of pipes or orifices in the lining of the furnace, and conveyed away to the fires. Whenever the materials within this cylinder descend below its mouth, as is frequently the case when the furnace is "scaffold-

ing," the atmospheric air—at all other times rigidly excluded—now obtains admission to this chamber. On these occasions the quantity of air which mixes with the gas is so great as to destroy its heating properties, and render it useless for generating steam.

That the increased consumption of fuel, and reduced make of iron, is owing to the abstraction of the gas there can be no doubt, for whenever the collecting apparatus is removed, or when, from any cause, it is not in operation, an immediate change is observed in the working and produce of the furnace.

Furnaces working with coke fuel evolve a large quantity of gas of considerable heating power; those working with semi-bituminous coal in the raw state give less gas and of a lower power, while furnaces using anthracite as a fuel give the least of any that have been tried.

As might be expected, these unlooked for results have completely checked the further application of the principle; but though the experiments made have thus far been unsuccessful, they have not yet been abandoned. The extent of capital swallowed up in alterations for the adaptation of the plan to the existing engines and stoves, and the hopes entertained by some of the most experienced iron-masters, that it will ultimately prove successful, have hitherto prevented this being done; but should the next twelve months not witness some important improvement on the present system of collecting and applying the gas, so as to obviate the disadvantages which now attend its application, it will be finally abandoned.

The non-success which has attended these attempts to economize fuel, by withdrawing the heated gases, &c., from the blast furnace, and applying them to other purposes, deserves the serious consideration of furnace proprietors in Pennsylvania and Maryland; for though the plan of connecting the hot air stove with the tunnel-head may not have an equally injurious effect on the working, yield, and produce of the furnace with the one described, there is too much reason to fear that it increases rather than diminishes the cost of smelting. A careful comparison of the coal consumed in converting the ore into pig iron, with that used in Welch furnaces working on the open plan, offers a ready means of ascertaining what advantages or disadvantages attend the respective systems. An inquiry of this kind would necessarily involve some time and expense, but the information derived from it would be of very great value to those interested.

Glamorganshire, Aug. 30, 1850.

The principal objections urged in the above article to this most important improvement in manufacturing iron, appear to be an increased consumption of coal, a diminished yield, and a tendency to scaffolding.

That the mere fact of using instead of wasting the gases escaping at the tunnel-head, after they have entirely finished their action on the charge, should seriously affect the working of the furnace, seems so strange a result as to lead to the suspicion that the mode in which the change was attempted may have had more share in producing it than the change itself.

It will be observed that all the furnaces spoken of above seem to have been altered for the purpose of collecting the gases in the same manner: that is, by sinking a wide-flanged iron pipe several feet from the tunnel-head, feeding the charges through the pipe, and collecting the gases from

the annular space left outside of it. In a passage thus made, both much narrower than before, and cylindrical in place of conical, the tendency of the materials to arch and jam is so much increased that the furnace must often lose, from these causes, the whole beneficial effect of the pressure of six or eight feet of its contents,—a loss of itself apparently sufficient to account for all the accidents of scaffolding mentioned in our correspondent's letter.

The serious effects upon both the yield and burden, produced by even slight alterations of the height and diameter of the upper part of a furnace are well known to iron-masters; many singular results of the experience on this subject in the Scotch and Staffordshire iron districts are recorded by Mr. Thompson in the *Transactions of the Glasgow Philosophical Society.*

By drawing off the gases through lateral flues near the top of the stack, in the manner originally practised in Germany, the previous form of the furnace can be preserved unchanged, and under such circumstances only can a fair trial of the merits of the system be expected.

The application of the waste flame to heating the blast has, in this country, been in general use almost as long as the hot blast itself, and we believe that it has, for several years, been successfully applied to raising steam. We hope, therefore, that some of our own manufacturers will favor us with results of their experience on this interesting subject.

R. A. T.

For the Journal of the Franklin Institute.

Remarks on Radial and Vertical Paddle Wheels. By T. W. Bakewell.

An investigation of the comparative merits of the radial and vertical paddle wheels, for steam vessels, is given by B. F. Isherwood, Esq., Chief Engineer U. S. Navy, in the August and September numbers of the *Journal.*

This investigation of Mr. I. suggests the bringing to notice, through the same medium, an important error, not peculiar to Mr. Isherwood, but adopted, it is believed, by all orthodox writers on the subject.

The error involves an injustice to the radial wheel in assigning a loss, *i. e.* power unprofitably applied, by the oblique action of the paddle on the water.

The distance advanced by the vessel, and retired (slipped) by the paddle, *together*, determine the amount of power or steam used: in other words, the two slips, that of the paddle and that of the vessel.

There is no slip of the vessel vertically, and if we give the entering paddle its greatest obliquity, (horizontal,) the wheel being immersed to the shaft, then the slip of the paddle would alone remain, which if resisted, the engine would be stationary. This example covers all the minor positions of obliquity.

Mr. I. estimates the slips of the radial and vertical paddles about equal, and observes, "The comparison is then narrowed down between the loss by oblique action of the radiating paddle wheel, and by friction of the moving parts, and reaction of the perpendicular paddle wheel;" and states, that, in usual practice, the loss by slip, with a 28 feet diameter wheel, is

about 18 per cent., and the loss to the *radial wheel* by oblique action about 18½ per cent.

The result of Mr. I.'s examination makes the efficiency of the two kinds of wheels nearly equal, while impaired by the above error of 18½ per cent. loss, ascribed to obliquity of action in the radial wheel.

Cincinnati, Ohio, 1850.

On Certain Phenomena of Forced Dilatation of Liquids. By M. MARCELIN BERTHELOT.*

If a somewhat strong capillary tube, closed at one end and drawn out at the other to a slender point, is filled with water at the temperature of 28° or 30° Cent.; if this tube is cooled down to 18°, so as to cause a certain quantity of air to enter it at the open point, and it is then closed, and again heated to 28° and gradually higher, after a certain time the air is completely dissolved. If cooled to 18°, the original temperature at which the tube contained at the same time gas and liquid, it is seen that the water continues to occupy the whole of the internal capacity, and maintains thus an invariable density between 28° to 18°. Its temperature may even be lowered still more. At this moment the least shock or collision, the least variation, causes the instant re-appearance, with a sort of ebullition, a slight noise, and a shock more or less perceptible, of the gas dissolved in the water. It dilates rapidly, and in less than a second has resumed its primitive volume at 18°. I have made the same observations with the following liquids, selected from all classes: water, solutions of various salts and gases, solution of soda, various acids, alcohol, ether, acetone, Dutch liquid, essence of turpentine, oil of olives, kreosote, sulphuret of carbon, chlorides of metalloids and metals, bromine. Mercury is the only liquid with which I have not succeeded, either in the presence of the air or *in vacuo*. A bubble of air remained several days in presence of the mercury without dissolving, at least completely, and that under pressures of 200 to 300 atmospheres, produced by preventing for that length of time the dilatation of the mercury due otherwise to an increased temperature of 8° to 10°.

In these phenomena there are two things very distinct. 1. An unstable supersaturation of the liquid by the gas, produced under the influence of the pressure. There are numerous examples of this order of facts. 2. A state of forced dilatation of the liquid; the latter, in fact, an instant before the vibration, fills the volume which the gas occupies an instant after conjointly with it, and this volume is the same which the dilated liquid filled on an elevation of temperature of 8° to 10° and more. The variation of density thus produced is enormous; for water it is equal to $\frac{1}{4\frac{1}{2}\frac{1}{0}}$th of its volume at 18°; for alcohol to $\frac{1}{9\frac{1}{3}}$, for ether to $\frac{1}{5\frac{1}{3}}$. Such an effect would be produced in an opposite direction only by a pressure of 50 atmospheres for water, of 150 for ether. This phenomenon is very general, as is proved by the variety of the liquids on which I have operated. It probably accompanies all supersaturations, but at variable degrees and in various directions, without being capable of being proved.

* From the London, Edinburgh, and Dublin Philosophical Magazine, for August, 1850.

Following the advice of M. Regnault, I endeavored to separate the two facts, and to produce the dilatation of the liquids *in vacuo*. A peculiar apparatus enabled me to fill the tubes with liquids absolutely freed from air, and to close them without letting any gas enter. Under these new conditions, I reproduced the phenomenon of forced dilatation with water and ether, and have thus seen that it is independent of supersaturation. This permanence of the density of the liquids in an interval of temperature more or less considerable, appears to me attributable to the adhesion of the glass and the liquid: it is a force which is opposed to the division of this latter; and which can only be destroyed by an increase of the molecular attraction of the liquid for itself, an increase produced under the influence of cooling.—*Comptes Rendus*, June 24, 1850.

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*Statistics of Gas in England and Wales.**

There are now in England and Wales 560 proprietary gas works, and in Ireland and Scotland 170. Besides these there are thirty-three which belong to private individuals, and twelve the property of municipal bodies or parish officers; in all, 775 distinct establishments for the manufacture and sale of gas. In these works a capital of 10,500,000 is said to be invested. The quantity of gas annually produced is about 9,000,000,000 cubic feet, and the coal consumed in making it weighs 1,125,000 tons. The number of persons employed in its production is about 20,000; and probably an equal number finds employment in the preparatory work in the mines, iron-works, and other processes connected with it. After allowing for waste and leakage, the quantity of gas actually sold to the public, in the year, is about 7,200,000,000 feet, producing a light equal to what would be given out by 32,133,640 gallons of sperm oil; which, at eight shillings a gallon, would cost the consumers £13,223,456. The gas itself is charged by the companies about £1,620,000.

On a New Voltaic Battery. By Prof. H. Reinsch.†

Prof. H. Reinsch, in the *Jahrbuch* of Practical Pharmacy, describes a new voltaic battery of considerable power without the use of any exciting metal. A common porous cell is filled with powdered coke, into which is fixed a rod of coke for conducting the current. This porous cell is placed in a jar or glass, which is then filled with coarse bruised coke, to which is also connected a rod of the same material. The coke in the inner cell is moistened with nitric acid,—that in the external one with a solution of common salt; conducting wires being attached to the coke cylinders, a tolerably strong current is indicated. Dr. Reinsch has rendered a small electro-magnet sufficiently magnetic by this current to sustain half a pound; but a large electro-magnet was not affected by it. The spark and shock have been very decidedly obtained from a single compound cell; and from the indications afforded, we may hope to obtain much greater power at a small cost of material.

* From the London Civil Engineer and Architect's Journal, for August, 1850.

† From the London Athenæum, for July, 1850.

On Certain Conditions of Freezing Water. By MR. FARADAY.*

The chief object of Mr. Faraday's discourse was the great, various, and extraordinary forms of affinity which exist between the particles of water. Having experimentally illustrated the combining power of water, and shown how this attraction passes from a physical to a chemical force, Mr. Faraday confined the rest of his discourse to ice, as being that condition of water in which its particles are allowed to associate with each other without the intervention of foreign matter. Such ice as is now imported into this country under the name of the Wenham Lake ice (though it is chiefly supplied from Norway) may be regarded as one of the purest natural substances.

Mr. Faraday first showed how entirely coloring matter, salts, and alkalies are expelled in freezing. A solution of sulphate of indigo, diluted sulphuric acid, and diluted ammonia, were partially frozen in glass test tubes; as soon as the operation had been carried on long enough to produce an icy lining of each tube, the unfrozen liquid was poured out and the ice dislodged. This ice was found in every instance perfectly colorless, and when dissolved, perfectly free from acid or alkali, although the unfrozen liquid exhibited in the first experiment a more intense blue color, in the second a stronger acid, and in the third a more powerful alkaline reaction than the liquor which was put into the freezing mixture. Mr. Faraday also devised a method for making this ice perfectly clear and transparent as well as colorless. By continually stirring the liquid, while freezing, with a feather, he brushed away globules of air as fast as they were dislodged from the freezing fluid, and thus prevented their becoming imbedded in the ice.

Having noticed the rapidity with which water absorbs air as soon as it is thawed, Mr. Faraday called attention to the importance of this natural arrangement to aquatic plants and animals, to whose life air is as indispensable as to those which live on land. Mr. Faraday then referred to Mr. Douny's discovery that water, when deprived of air, does not boil till it reaches the temperature of 270°, and that at that degree of heat it explodes. He mentioned that he suggested to Mr. Douny that ice, when placed in oil, (so as to prevent its receiving any air from the atmosphere on thawing,) would probably explode on reaching the boiling temperature. This experiment had been successfully tried by Mr. Douny, and was as successfully repeated on this occasion.

Mr. Faraday then invited attention to the extraordinary property of ice in solidifying water which is in contact with it. Two pieces of moist ice will consolidate into one. Hence the property of damp snow to become compacted into a snowball—an effect which cannot be produced on dry hard-frozen snow. Mr. Faraday suggested, and illustrated by a diagram, that a film of water must possess the property of freezing when placed between two sets of icy particles, though it will not be affected by a single set of particles. Certain solid substances, as flannel, will also freeze to an icy surface, though other substances, as gold leaf, cannot be made to do so. In this freezing action latent heat becomes sensible heat, the contiguous particles must therefore be raised in temperature while the freezing

* From the London Athenæum, for June, 1850.

water is between them. It follows from hence that, by virtue of the solidifying power at points of contact, the same mass may be freezing and thawing at the same moment, and even that the freezing process in the inside may be a thawing process on the outside.

Mr. Faraday then referred to Mr. Thomson's memoirs on the effect of pressure on the freezing point. Mr. Thomson has shown that immense pressure will prevent water from freezing at 32°—ice naturally occupies a greater volume than that of the water which forms it. And we may conceive that when ice is pressed the tendency is to give it both the water bulk and state.

In conclusion, Mr. Faraday noticed briefly, and chiefly by way of suggestion, the molecular condition of ice as presenting many curious results, and called attention to the strangeness of stiræ being formed in a body of such uniform composition as pure water frozen into ice.—*Proc. Roy. Inst.*

FRANKLIN INSTITUTE.

Proceedings of the Stated Monthly Meeting, September 19th, 1850.

Samuel V. Merrick, President, in the chair.
Thomas Fletcher, Vice President.
Isaac B. Garrigues, Recording Secretary.

The minutes of the last meeting were read and approved.

Donations were received from The Royal Cornwall Polytechnic Society, England; The American Cannel Coal Co., Louisville, Ky.; John McRae, Esq., Charleston, S. C.; Prof. Caleb G. Forshey, New Orleans, La.; Dr. R. S. W. Rushenberger, U. S. Navy; Prof. John S. Hart, Messrs. Prosper Martin, Henry Whitall, Robert Frazer, and Solomon W. Roberts, Philadelphia.

The periodicals received in exchange for the Journal of the Instit were laid on the table.

The Treasurer read his statement of receipts and payments for the month of August.

The Board of Managers and the Standing Committees reported their minutes.

The resolution reported by the Committee on Exhibitions at the last meeting was amended and adopted.

New candidates for membership in the Institute (17) were proposed, and those proposed at the last meeting (5) were elected members of the Institute.

Geo. W. Smith, Esq., offered the following preamble and resolution, which were unanimously adopted, as follows:

Whereas, Mr. I. W. P. Lewis, Civil Engineer, has on several occasions personally appeared before the stated monthly meetings of the Franklin Institute of the State of Pennsylvania, and ably explained at great length the improvements in the illumination of lighthouses by the introduction of the Dioptric system, and illustrated the subject by numerous large and well designed drawings, as well as by the actual exhibition of revolving, fixed, and flashing Dioptric Lights, of the actual size in use, which had been

procured by him at great expense, and for which he has declined any remuneration: Be it therefore,

Resolved, That the Franklin Institute has heard with high interest the statements of Mr. Lewis, and view with much pleasure his early, zealous, intelligent, and long continued efforts to introduce the Dioptric system into use in the United States,—a system which has already received the unanimous approval of this body.

Resolved, That the thanks of the Franklin Institute be given to Mr. Lewis, for the gratification which he has afforded to it, and also for his courtesy and liberality in loaning it the Dioptric Apparatus at the last Annual Exhibition.

The President having stated that he had received an invitation from the Massachusetts Charitable Mechanics' Association, at Boston, to the Franklin Institute, to be present by its delegation at the Exhibition of Manufactures now being held there, the following resolutions were offered by Dr. Turnbull and unanimously adopted, viz:

Resolved, That the thanks of the Franklin Institute be returned to the Massachusetts Charitable Mechanics' Association for their kind invitation, and that the President be authorized to appoint delegates to the Boston Exhibition.

Resolved, That an invitation be given to the Massachusetts Charitable Mechanics' Association to be present by their delegation at the Exhibition of American Manufactures to be held by the Franklin Institute in this city, between the 15th and 26th days of October next.

Mr. G. W. Smith called the attention of the meeting to a printed copy of a letter from Mr. James McQueen, dated London, August 26th, 1850, stating that the sources of the Nile had at last been ascertained, in its main or eastern branch, by recent journeys from the north and from the south-east coast of Africa, Portuguese travelers having recently made us acquainted with the sources of the western branch. The expedition of the Pacha of Egypt, in January, 1840, traced it at that time to lat. 3° 22′ N., and long. 31° 41′ E., there 1300 feet broad, and coming from the south-east, from a lake. From that point to the source is a distance, in the general bearing, of 270 geographical miles, sufficiently great to form a river of that magnitude, especially in a country so mountainous as that portion of Africa is found to be.

The Rev. Dr. Krapf, a missionary from the Church Missionary Society, long stationed in Eastern Africa, has at length obtained this important information. In a journey, he reached lat. 1° S., and long. 35° 30′ E., to Kitui, the capital of Unbekani, a fine and friendly people. There he saw to the north-west, distant about six days journey, Mount Kenia rising far above the limits of perpetual snow, (the Chimborazo of Africa, and under the equator,) from the southern base and side of which springs the river Dani; and to the north of it, he was told, rose a river running to the north, down which the people went to the country of the white people,—doubtless the Nile. Thus the information given to us by Martin of Tyre, by Bruce, and by the Priests of Egypt, in their communications to Herodotus, are at length confirmed, and the physical peculiarities of the river satisfactorily accounted for. The Nile is, therefore, not only the longest river on the earth, but runs through more degrees of latitude than any known.

An excellent transparent substance, well adapted to replace the marine glue of Jeffries for many purposes, particularly where a transparent joint is required, as in the union of pieces of glass, invented by Mr. S. Lenher, of Philadelphia, was exhibited, and its properties explained. From its transparency, it was suggested by the Chairman, Mr. G. W. Smith, as admirably adapted for the union of the parts of polyzonal lenses and rings. Small glass boxes, for containing microscopic objects, united by it, were shown, and gave much satisfaction. The composition of the cement is as follows: caoutchouc 15 grs., chloroform 2 oz., mastic ½ oz. The two first named ingredients are to be first mixed; after the gum is dissolved the mastic is added, and the whole allowed to macerate for a week, which is about the time required for the solution of the mastic in the cold. More of the caoutchouc may be added where great elasticity is desirable. The convenience of its application with a brush, cold, recommends it for approval.

Some microscopic preparations of Dr. Paul B. Goddard, of Philadelphia, in which the most minute vessels of the human body were most admirably injected with vermillion, &c., were described by the Chairman. The vermillion being previously very finely ground in oil, was mingled with sulphuric ether, and slowly injected with a very fine syringe. The exquisite beauty of these specimens attracted much attention and deserves especial notice.

Mr. G. W. Smith alluded to the various catoptric and dioptric light-house apparatus, whereby a large portion of the sphere of light emitted from lamps placed in the foci thereof was economized, and especially drew the attention of the meeting to the singular fact, that, of the whole cone of light projected to the horizon from either lenses or reflectors, the whole of the upper half of the cone, being projected above the horizon, is totally wasted, being visible only to birds in the air or to men in balloons. He suggested the inclination of the lenses or reflectors, (as the case may be,) so that the axis of the projected cone may be directed, not to the horizon, but slightly *below* it. He called on the members at the meeting for some explanation of the causes of this useless waste.

I. W. P. Lewis, Esq., C. E., being present, admitted the waste, and suggested that, in order to obviate it, the apparatus must be varied in its position in lighthouses according to their heights, which might be attended with inconvenience in the manufacture of apparatus, and the adjustment of them at the place of use.

Some discussion took place respecting new lighthouses now in progress in the United States, in which the dioptric system is to be introduced, the intelligence of which facts seemed to interest the meeting.

The Holophotal Sphere of Mr. Thomas Stephenson, C. E., of Scotland, was explained to the meeting and illustrated by drawings. This instrument is intended to economize all the light emitted by a lamp placed in its focus. The anterior half of the sphere is precisely similar to an analogous invention of Mr. G. W. Smith, of Philadelphia, made about two years ago, and submitted to the Franklin Institute subsequently for examination, a drawing of which is contained in a previous number.

The novelty of Mr. Stephenson's plan consists in the posterior half of the apparatus, the interior of which is a perfect hemisphere, the exterior consisting of rings placed in parallel vertical planes. Any portion of these

rings receiving the light emitted from its centre, at right angles on its interior surface, the ray penetrates without refraction to the exterior surface of the ring, which is curved in a paraboloidal form—is there reflected totally to the opposite surface, curved in a similar manner; thence again reflected totally from a similar surface on the opposite side of the ring to the central focus, whence it is emitted, and thus reinforces the rays of light falling upon the anterior portion of the dioptric apparatus. All the light is thus rendered available, excepting that small portion absorbed in the passage through the glass, and the portion intercepted by the lamp itself.

Dr. Rand exhibited to the meeting the Prussian Rifle, as improved by Mr. John Würfflein, Jr., of the firm of Würfflein & Psotta, gunsmiths, of Philadelphia. This gun is celebrated as having been used with great effect against the Danes in the Schleshwig-Holstein war, and is remarkable for its long range. The principle of the weapon, which loads at the breech, is that of lighting the powder of the charge at the upper portion, so that it ignites backwards. This is effected by placing the percussion powder in the cartridge next the ball; this percussion powder is ignited by means of a needle, which, when the trigger is pulled, starts from the breech of the gun, traverses the axis of the cartridge, and explodes the percussion powder, and, consequently the whole charge from before backwards. The mechanism of the lock is, as improved by Mr. W., highly ingenious, while at the same time it is more simple than an ordinary gun lock. It is provided with a safety apparatus, which renders an accidental discharge of the piece almost impossible. But few experiments have as yet been made with this rifle in this country; at one trial it was found, at a point blank shot of 150 yards, to drive the ball through a 4-inch cedar plank; its maximum range has not been yet ascertained.

Dr. Rand also presented a very light short rifle, made by the same firm, which is characterized by having projecting into the barrel, in its axis, from the breech, a short stiff iron pin, a little over an inch long; the ball rests on this pin when driven home. By this arrangement the lead of the ball is forced into the rifles without the grains of the gunpowder being crushed. This rifle, at a distance of 350 yards, with an elevation of a quarter of an inch, drove its ball through a pine plank an inch thick. It is so light that it might be fired with one hand.

Mr. Grimes introduced and described his apparatus for showing upon a graduated column the height of water in a steam boiler, as well as the pressure of the steam. This apparatus will be more fully described hereafter.

Committee on Science and the Arts.

Report on Seth E. Winslow's Lamps, for Burning Camphene, &c.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania, for the Promotion of the Mechanic Arts, to whom were referred for examination—"Lamps for Burning Camphene, &c.," invented by Mr. Seth E. Winslow, of Philadelphia, Pennsylvania,—Report:—

That they have examined the lamps, and that some of the Committee have made use of them. The improvement consists in the employment of a double system of lampwick instead of the single continuous wick used heretofore. One portion of wick passes down into the fluid, and, by the